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Manufacturing Automobile Pistons in a Jobbing Shop

Manufacturing on a Small Scale Made Possible in the Job Shop by the Use of Simple Tools and Fixtures

By ROBERT MAWSON

READERS of technical magazines are well aware of the many excellent articles which have been published describing the manufacture of automobile pistons. The builders of automobiles however have the advantage of making only the particular type of pistons used in their cars, and can tool up in the way of jigs, fixtures and special machines accordingly.

The Dyer Co., Cambridge, Boston, Mass., however, had to meet a different propcsition in that it is producing pistons for a variety of different makes of automobiles and the tools employed must be designed to be somewhat flexible so that they may be changed if necessary to machine other pistons slightly different in design.

In Fig. 1 is shown a portion of the piston machining department, from which some idea of the quantity of various types of pistons made may be gathered.

Some of the pistons to be seen are in the rough while others are ready for the final operations of grinding and inspection. It will also be observed that the shop is kept in an orderly manner; the aisles free from castings, and the pistons stacked against the machines in a manner convenient for the operator.

A casual examination of automobile pistons will show how they vary in design, though many of the variations are so slight that the layman often wonders if it would not be an advantage if some standard were adopted, as by so doing repair parts could be obtained more readily and at less cost.

So long as each manufacturer thinks that his automobile and its particular parts are the best on the market, the user of cars will have to wait for a time before standardized parts are made.

The first operation in machining the pistons is shown in Fig. 2. This is centering the head end. The piston

FIG. 1. THE PISTON DEPARTMENT.

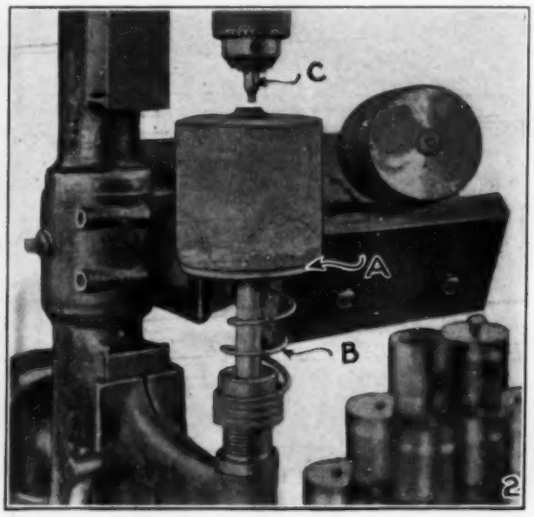


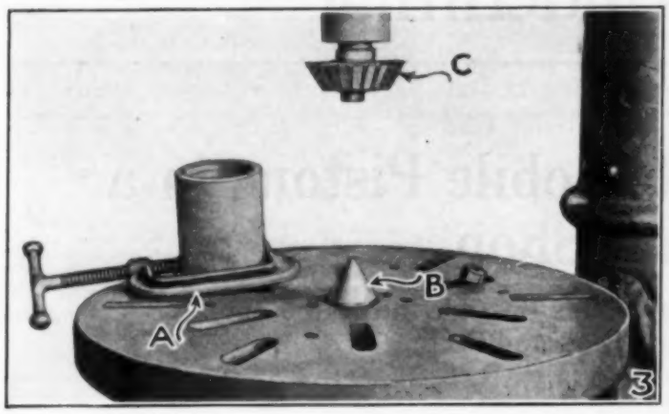
FIG. 2. CENTERING THE HEAD END

is located on the snout-nosed center *A* which is forced upward by the spring *B*. Should the operator crowd the center-drill *C* too much, the work will be pushed down against the spring and many breakages of drills will be prevented. One of the pistons after being centered in this operation is shown at the right of the drilling machine.

The next operation is centering the open end of the piston and the drilling machine set up for this purpose is shown in Fig. 3. The piston is held by means of a C-clamp as shown at *A* and placed with the end centered in the previous operation on the center *B*. The 45-deg. cutter *C*, attached to the machine spindle, is then fed down into the open end of the piston for a slight distance, thus forming a beveled seat.

The pistons are then rough-turned, and a rear view of one of the lathes used, with the piston removed, is shown in Fig. 4. The open end of the piston is placed on the snout-nosed center *A* and supported at the other end by the tail center of the lathe.

The driver *B* fits inside the piston between the pin bosses, thus adapting itself to any variations in the castings. The turning tool may be seen at *E*. In this operation the pistons are left about $\frac{1}{32}$ in. oversize. Fig. 5 shows the operation of rough-facing the head end, the



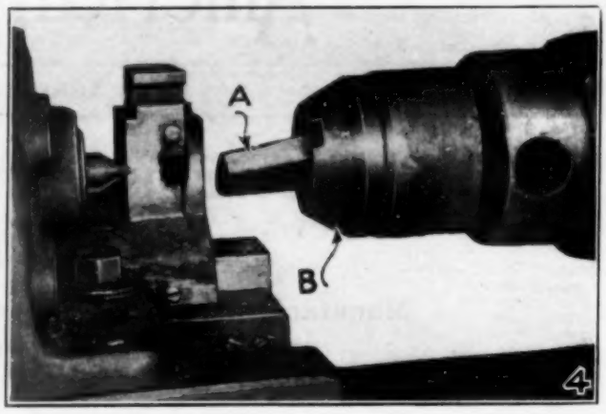
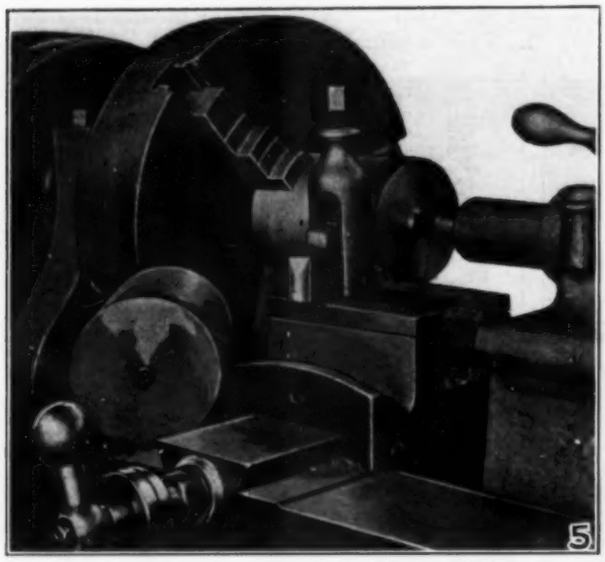


FIG. 3. CENTERING THE OPEN END. FIG. 4. ROUGH-TURNING THE BODY



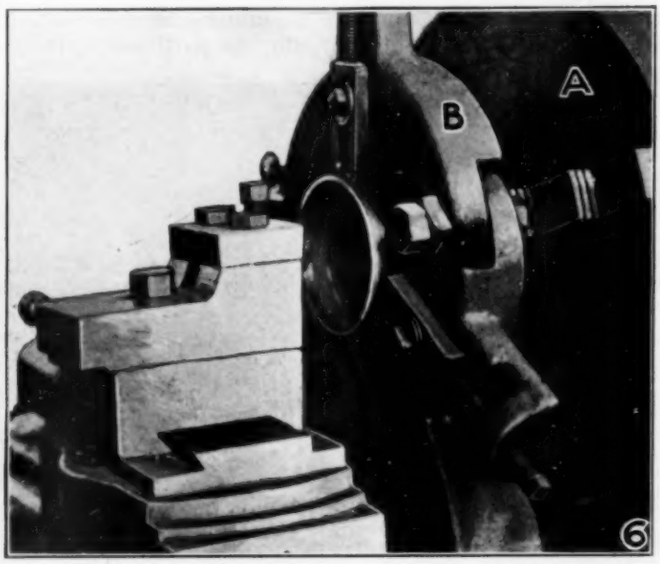
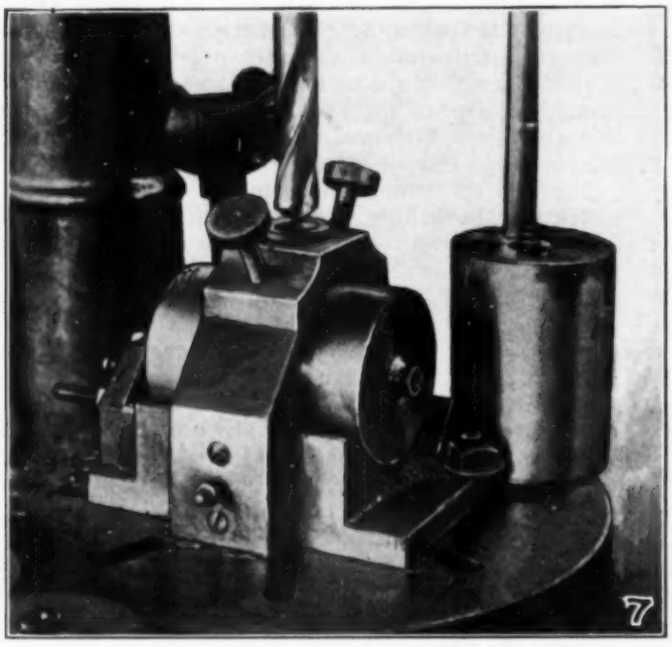


FIG. 5. ROUGH-FACING THE HEAD END. FIG. 6. FACING THE OPEN END



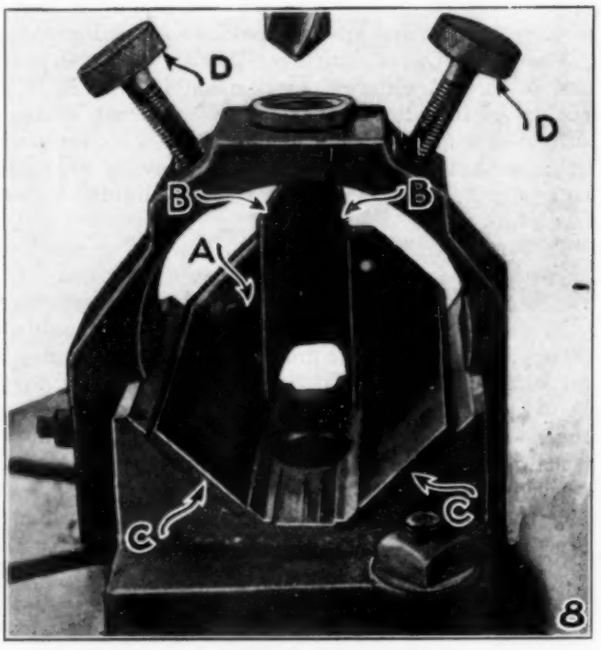


FIG. 7. DRILLING WRISTPIN HOLE. FIG. 8. JIG FOR DRILLING WRISTPIN HOLE

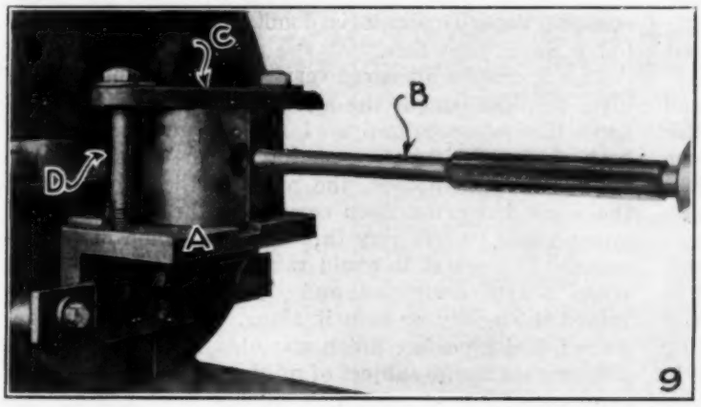
piston being left about $\frac{1}{8}$ in. overlength. The piston is held in a three-jawed universal chuck, and the lathe carriage is locked after it has been set to the proper position to give the desired length. The cross-feed of the lathe is then put into operation and the piston end faced. One of the pistons before being faced is shown resting on the lathe carriage.

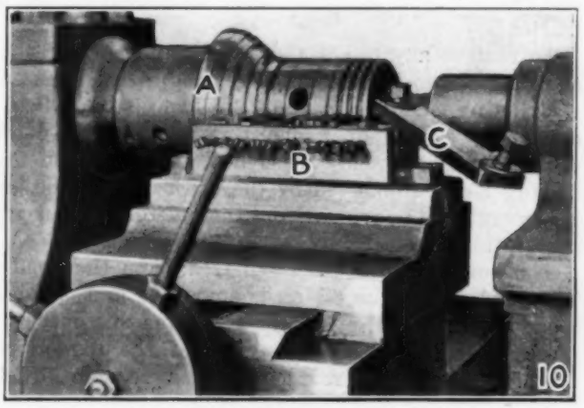
The next operation is facing the open end and is illustrated in Fig. 6. The piston is located against the end of the lathe spindle and held by means of the three-jawed universal chuck *A*. The outer end of the piston is supported by the steadyrest *B*. With the piston in this position the open end is faced, leaving the length about $\frac{1}{16}$ in. over the finished dimension. The beveled surface is also trued up at this setting. The piston is then finish-turned leaving it about $\frac{1}{32}$ in. over size.

holes in the correct position in relation to the wristpin bosses.

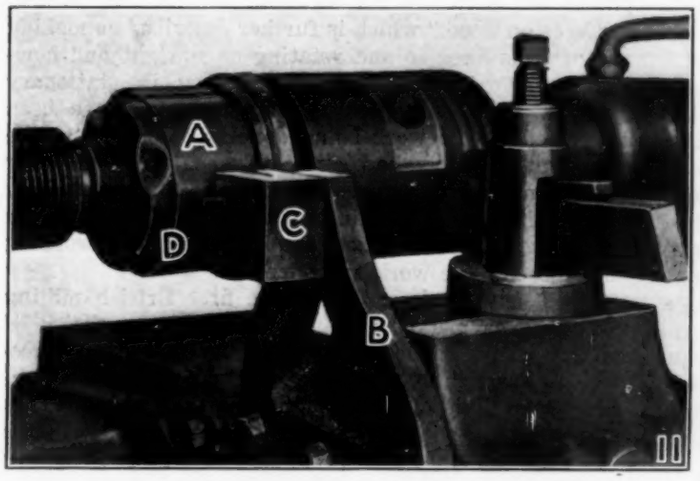
Packing strips *C* are employed in the jig so that it may be used for other diameters of pistons which have wristpin holes at the same distance from the open end. After the piston has been located as described, the two knurled screws *D* are tightened, thus holding it securely. The hole drilled is $\frac{1}{8}$ in. smaller than the finished size.

The wristpin holes are then reamed as shown in Fig. 9, leaving $\frac{1}{64}$ in. for the final hand-reaming operation. The piston is placed on the angle plate *A* so that the wristpin hole will be central with the lathe center. The reaming bar *B* is then fed through the piston, the clamp *C* holding the piston securely. The rear of the fixture is made with a guide at *D*, the hole being the correct diameter to suit the long pilot on the reamer *B*.





FG. 9. REAMING WRISTPIN HOLE. FIG. 10. MACHINING THE GROOVES



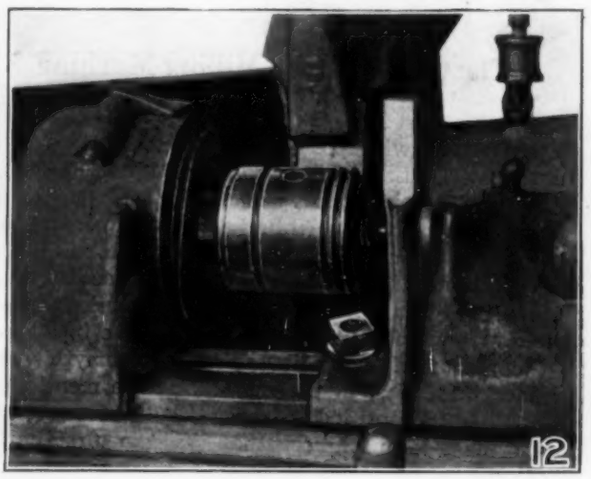


FIG. 11. CUTTING THE RELIEF. FIG. 12. GRINDING THE BODY

This operation is performed in a lathe similar to that shown in Fig. 4.

The piston is then finish-faced to length. For this operation it is located on and driven by a snout-nosed center of similar design to that already described. After the piston has been removed from the lathe the length is given a final check with snap gage to test its accuracy.

The piston is now ready for drilling the wristpin holes, which is the next operation and is shown in Fig. 7. The piston is located in the jig against the stop *A*, Fig. 8. Two steel plates *B* are attached to the rear of the jig and straddle the wristpin bosses, the piston being placed in the jig with the open end toward the rear wall. This method of locating insures drilling the

It is easy to see how this fixture can be changed to suit various sizes of pistons, it being only necessary to change the position of the angle plate *A*.

Machining the piston ring grooves is illustrated in Fig. 10. The piston is placed on a snout-center at *A*, and supported by the tail center at the head end. The grooving toolblock may be seen at *B*. The various tools are made of rectangular steel bars, separated with spacers of the proper thickness to obtain the correct location of the various grooves.

The tools are set out by means of the screws shown to obtain the desired depth of grooves. After this has been done the clamp *C* is swung into position and the screws tightened to hold the tools rigidly in place.

A variety of pistons can be grooved with this tool-

head, it being only necessary to change the separate tools and spacers to conform to the required spacing and depth.

The pistons are then relieved around the wristpin holes, this operation being shown in Fig. 11. The piston is held and driven by means of a snout-nosed center as previously described, the head end being carried on the lathe center.

The cam *A* is made with two depressions which come in line with the wristpin holes of the piston. On the bracket *B*, fastened to the lathe carriage, is attached the block *C* which is provided with a hardened steel roller revolving on the pin *D*.

In operation, the crossfeed screw being disconnected, the roller follows the contour of the former, the tool being held against the piston by means of the weight and the material is turned away as shown by the illustration.

To remove any burrs and to insure a perfect beveled edge the piston is then finish-reamed at the open end.

Grinding is shown in Fig. 12. The piston is held and driven by means of a snout-nosed center of similar design to that already described, the head end of the casting being supported by the tail center. The grinding operation is obvious from the halftone and needs no description.

The boss or tit is then removed from the head end. The head end of the piston is smoothed and polished in a double disk-grinding machine. After this operation it is transferred to the other side of the disk-grinding machine which is provided with a scratch brush to remove burrs or dirt from the grooves.

The piston is now hand-reamed for the wristpin holes and given a final inspection.

The Origin of the Milling Machine

By F. P. Terry
Belfast, Ireland

I have read with pleasure the contribution on this subject by L. L. Thwing, on page 1085, Vol. 54, of *American Machinist*. His sketch, Fig. 1, is particularly interesting but the machine shown is not, I think, entitled to any claim as the first British milling machine; although Mr. Thwing's surmise as to its age being 1845 would be correct. The work shown, a double throw crank, is of a type that came into general use very soon after the invention of Nasmyth's steam hammer in 1839; and the machine above mentioned is no doubt more entitled to rank as one of our earliest single purpose machines, than as the first milling machine.

Having read all the contributions on this subject which have appeared in the *American Machinist* during the past twenty years, I would ascribe the origin of the milling machine in America to Eli Whitney (described by J. W. Roe, page 1037, Vol. 31) and its origin in Britain, if not in the whole world, to Maudsley and Nasmyth.

The evolution of the milling machine may be said to have commenced after the introduction of the slide rest by Maudsley about 1790. It is well known that Maudsley invented many machines and appliances for the manufacture of Bramah locks, some of which, we may safely assume, consisted of revolving cutters used in the lathe and operating upon work fixed in some way to the slide rest. This method was known as hobbing, and in the old days many interesting operations were performed in this way.

Away back in the eighties I was serving my apprenticeship in a shop that constructed a sewing machine having a serrated feed wheel about 3 in. in diameter by ⅛ in. wide. The machining of these wheels, which were completed in the lathe, was looked upon as a fine job for a boy, and many schemes were tried to get on this lathe. I well remember my turn.

The wheels were bored and turned in the usual way, after which they were dropped flat on to a pin in a small fixture attached to the toolpost. For cutting the teeth a hob about 15 in. in diameter by 1 in. wide was placed between the centers. It was correctly threaded to suit the serrations, of teeth, and fluted to present cutting edges but not relieved in any way. It was revolved slowly and the work was fed in to the proper depth, the hob revolving the work and completing the serrating in about two minutes. Considering labor costs of those times, it is doubtful if any method of today would beat this.

This operation appeared very simple, and so it was—after you had bought the secret from the boy who had done the job previously. I well remember spoiling half my first bath before paying up for the secret.

As before mentioned, the pitch of the hob revolved the work, but often upon coming to the last tooth the latter would be left very thin or there would be a wide space. The secret to avoid this was to grip the work when nearly completed and by eye judgment alone retard it slightly or help it along, whichever was preferred, and a perfect finish was obtained.

To return to the subject of milling. In 1802 Maudsley commenced the construction of his blockmaking machinery, and in the same year Bramah took out a patent for a "producing straight, smooth and parallel surfaces on wood," which is further described as making use of tools fixed to and rotating on upright and horizontal shafts, and other tools sliding in stationary grooves. This invention may or may not have been suggested by the work being done by Maudsley at the time, but probably had some influence in introducing the milling machine, as a little later we find (as already described by H. H. Manchester) that attempts were being made to strengthen and arrange wood working machines for the working of metals.

What may be described as the first British milling machine was made by Maudsley in 1829, a sketch of which appears in the "Life of Nasmyth" and in connection with which Nasmyth is credited with the invention of the dividing head. Mr. Nasmyth designed this head together with a revolving cutter to work in the headstock of the lathe for the purpose of milling hexagon nuts with a circular collar; this he describes as so successful that an enlarged edition of this collar nut cutting machine was soon introduced in the works and became a specialty of manufacture. Later, when in business for himself, he manufactured it, and he states that it was in great demand among mechanical engineers. Thus we may assume that the manufacture of milling machines commenced in 1829 by Maudsley and in 1834 by Nasmith, followed later by Whitworth, Smith & Coventry and others.

The machine of Maudsley's, which is on similar lines to that of Eli Whitney, can, I think, be designated the first British milling machine; due allowance is made for other revolving cutter machines of Bramah, of Wilkinson (inventor of boring machines), and the hobbing methods which originated with Maudsley and were carried further by others.

The Economics of Production

VI. THE PRODUCER'S JOB AND PROFITS

By Prof. D. A. McCabe, Ph.D.

WE HAVE TRIED to make clear in the previous articles that production depends upon demand and must be adjusted to it. A point that has come out again and again is that the producer cannot fix both the prices and the quantity to be sold. He may fix a price and accept the decision of the demanders as to the quantity that will be taken. Or he may fix a quantity and then await the decision of the demanders as to the price that will be paid for that quantity. He cannot fix both. It must be understood that when we speak of producers fixing the quantity to be produced, we do not mean that the producers fix the *total* quantity of their kind of goods. Each producer fixes *his own* quantity and that alone. He has no say as to what the total quantity is to be. He has to take his chances on that, unless, of course, he is the only producer in his line. This does not mean merely that he makes a patented or trade-mark article. There may be a dozen different models or types of the same kind of article, all competing for the same demand. The advertising pages of this magazine afford many illustrations of this.

Nor may the individual producers get together and fix by agreement the total quantity to be produced in their line. That is absolutely forbidden by law. The ideal situation in the eyes of the law is one in which each producer adjusts his quantity to the probable demand without any consultation with the other producers as to what they are doing in the way of quantity or what they have in mind in the way of price. The ideal of the lawmakers is not always realized in practice. Yet it is generally true that the individual producer has to adjust his output not only to an estimated total demand but to an estimated total contribution of products from the other producers to meet that demand. He has to guess both on demand and on supply.

On the other side, what the individual producer can do in the way of production to meet the situation as he sees it depends upon his costs of production. He sizes up the probable demand and the probable output of the other producers and estimates the price he can get for this or that quantity. Then he looks to his costs. To a considerable extent these are also beyond his control, as has been pointed out. He must pay about the same prices for such things as coal, pig iron, steel ingots, supplies and equipment as others who use these things in production. The more they are worth to others as means of producing goods for which they find a demand, the higher will the cost of them be to the individual producer. Thus we see the producer standing between certain costs which he does not control, on the one side, and a total demand which he does not control, on the other. Alongside of him stand other producers of the same kind of goods also trying to estimate the total demand. Whatever the total demand turns out to be, it is clear that the quantity that can be sold in the aggregate will depend upon the price at which the goods are offered. It is also clear that each individual producer must be prepared to meet the price at which the others will sell if he is to get for himself his share of the sales. And finally, it is clear that his ability to do that at a profit depends largely upon what it costs him to produce.

The producer's job is not merely one of estimating the total demand, or that plus guessing what his competitors will do. He must also purchase materials, supplies, and even labor at about the same prices or rates that his competitors pay for them and turn out a product at a total cost that is less than the price the demanders will pay for a goodly quantity. That price can be no greater, of course, than the price asked by his competitors.

When demand is increasing the producer's job is not so difficult. When demand is stationary or declining, he can continue to produce at a profit only if he keeps his costs down inside the price he can get for a reasonable output.

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When demand is increasing the producer's job is not so difficult. When demand is stationary or declining, he can continue to produce at a profit only if he keeps his costs down inside the price he can get for a reasonable output. And this price, be it remembered, is influenced not only by the demand but by what the other producers are willing to accept. If they can produce for lower costs than he can, he must reduce his costs or lose.

It may be seen, therefore, that a business which produces at a profit under ordinary circumstances does it by keeping its costs of production as low, at least, as those of its competitors and lower than the price that the demanders are willing to pay for the quantity produced. If it pays the same prices for machinery, supplies and materials that its competitors pay and pays the same going rates of wages, without sweating its labor, it is doing its job well, as things go. The business may be owned by an individual, by a partnership, or by a corporation. Whatever the form of ownership, its job is the same and the profits are gotten by keeping its costs down below the price the demanders will pay for the total quantity turned out by all the producers in that line.

In the large and complex producing units of today, costs cannot be kept down without the co-operation of most of the persons in the organization. If workmen waste materials, if they leave tools around carelessly to be broken, lost or to gather rust, the costs will mount

alarmingly. But the workmen have nothing to gain by this, and few are likely to do it deliberately. On the other hand, costs are affected by the *quantity* of production turned out in a given time for a given expenditure for overhead and wages. If the workmen hang back on production, the costs will rise; if they turn out more, costs will ordinarily fall.

Which of these two policies is to the advantage of the workmen? Is their interest in production different from that of the owners? Are the wage interest and the profits interest inside the same business necessarily in opposition on the matter of the output of the individual workman? We have seen the relation between production and profits. What is the relation between production and wages? That will be the subject of the next article.

Volume of Liquid in a Horizontal Tank

BY H. J. GEERLINGS

The figuring of the amount of liquid contained in a partially filled horizontal cylindrical tank can be facilitated by the use of curves. Fig. 1 shows a curve used in determining the amount of liquid in a tank having flat ends, the inside length and diameter of the tank and the height of the liquid being known.

The method of developing the curve was as follows: Since the areas of two circles are directly proportional to the squares of their diameters, the areas of similar portions of circles are also directly proportional to the squares of the diameters. The curve is an area curve for a cylinder whose diameter is one, being developed by figuring a large number of spherical segments. From the curve, one can get the required per cent of the total area of the circle, which, multiplied by the square of the diameter of the tank in inches and the length in inches and divided by 231, gives the contents in gallons.

The following example shows the calculation necessary, although some of the steps can be combined. Find the volume of liquid standing 36 in. high in a tank 90 in. in diameter and 70 in. long.

Solution:

$36/90 = 0.4$, or 40 per cent of the diameter.

Following the 40 per cent line to the curve, then down to the horizontal scale, we read 0.293.

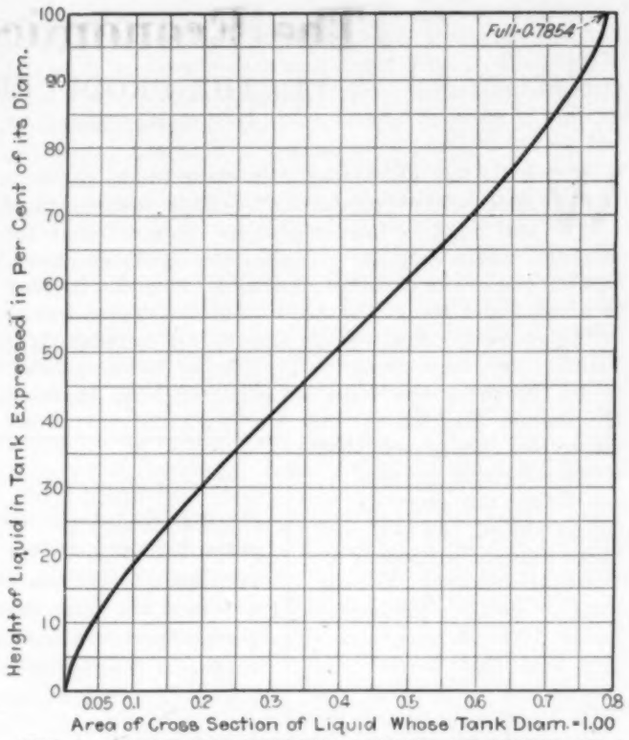

FIG. 1. CURVE FOR FINDING AMOUNT OF LIQUID IN A HORIZONTAL TANK

$0.293 \times (90)^2 = 2{,}374$ sq.in.

$2{,}374 \times 70 = 166{,}180$ cu.in. = volume of liquid

$166{,}180 \div 231 = 719$ gallons = volume of liquid

$166{,}180 \div 1{,}728 = 96.25$ cu.ft. = volume of liquid

SEMI-SPHERICAL-ENDED TANKS

In developing a curve to find the volume of liquid in a partially filled saucer end of a tank, the radius of the saucer being equal to the diameter of the tank, it is necessary to know only the height of the liquid and the tank diameter. Since the volumes of two spheres are directly proportional to the cubes of their radii, the volumes of similar portions of two spheres are also directly proportional to the cubes of their radii. The curve shown in Fig. 2 is a volume curve for the saucer end of a tank, the diameter of the tank and of the end being unity. The curve was developed by figuring many portions or segments of a saucer end having a diameter of one, and plotting the results.

To use the curve, get the height of the liquid in the saucer in per cent of the total height or diameter of the tank. From this value on the vertical scale, follow the horizontal line to the curve and drop down vertically to the horizontal scale. This reading gives the volume of the section of the saucer whose radius is one. Multiply the reading by the cube of the radius of the saucer to obtain the volume in the section of the saucer required.

The curves are quite accurate, working to within one-half of one per cent when made 10 in. high; and they have been of great help to the author.

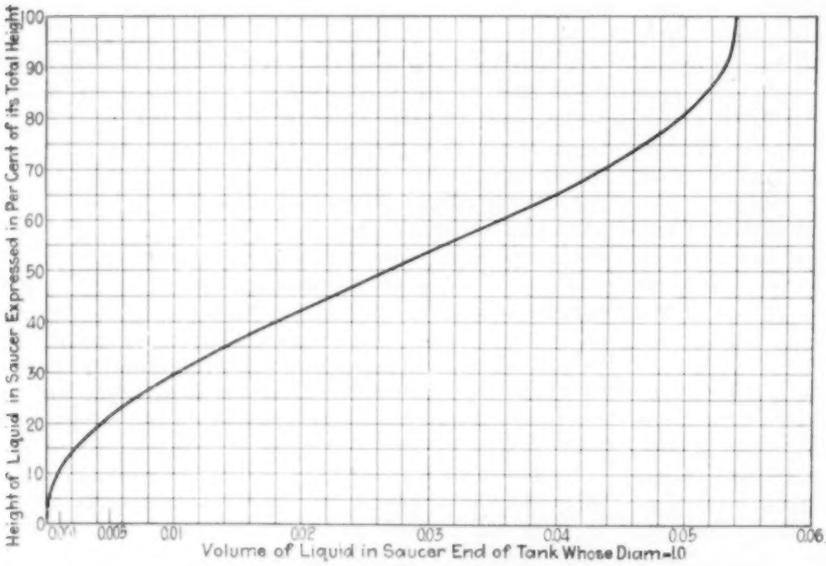

FIG. 2. CURVE FOR DETERMINING THE AMOUNT OF LIQUID IN A SEMI-SPHERICAL TANK END

Grinding Irregular-Shaped Holes on the Bryant Internal Grinding Machine

Handling Combinations of Straight, Tapered and Curved Internal Surfaces — Grinding Done in One Operation—Laying Out Special Control Plates

SPECIAL CORRESPONDENCE

THE construction and the method of operation of the internal grinding machine made by the Bryant Chucking Grinder Co. of Springfield, Vt., permits of the handling in one operation of a part having a hole of varying diameter, whether the hole be tapered, curved or irregular in section. The construction of the Bryant internal grinding machine is well known, but Fig. 1 is given to show the arrangement of the essential features of the machine.

The work is held in a rotating chuck at the left of the machine. There is no cross-slide; a one-piece member carries the wheel spindle and is suspended from a heavy shaft. The crossfeed motion of the wheel *W* is obtained by the swinging of the arm about the shaft, while the longitudinal motion arises from the axial movement of the shaft. A curved extension on the swinging member carries the control plate *P*, against which the feed screw presses. Due to the leverage, the movement of the wheel is only half that of the feed screw, which enables accurate control of the diameter.

Grinding a Taper

It will be evident that the principle of the design offers advantages for grinding not only straight and taper holes, but also curves and various combinations of these shapes. This is accomplished not by grinding with a formed wheel, but by traversing the wheel the full length of the hole. The wheel is caused to generate the desired shape by using a suitable control plate *P*. Since the plate or cam is attached to the arm of the wheelslide, it moves with it; and it remains in contact with the plunger in the end of the feed screw. Diameter control is obtained by manipulating the handwheel and it is said that exact duplication from piece to piece is easily maintained.

The machine as regularly furnished is equipped with a straight-edged control plate. For grinding straight holes this plate is lined perfectly true with the axis of the slide cylinder, which carries the slide box and wheel spindle. This slide cylinder moves laterally in its bearings to traverse the wheel, and it can also rotate in the same bearings for cross-feeding the wheel. The control plate is accurately pivoted and when it is desired to grind taper holes, it is swung to such a position as to cause the wheel to move at the desired angle. The work spindle, however, is left in position with its axis parallel to the axis of the slide cylinder.

The sketch in Fig. 2 shows the control plate in position for taper grinding. Since the plate has a leverage ratio of two to one over the grinding wheel, allowance must be made in proportion. However, the control plate is graduated, indicating the angle actually ground, or one-half the included angle. When grinding a taper the wheel is also trued to the same angle as the work. This is automatically taken care of as the slide has the same motion when the wheel is being dressed as when the hole is being ground. A standard plate provides for an angle of 30 deg. included, but an included angle as great as 90 deg. can be taken care of with a suitable control plate.

Fig. 3 illustrates a combination of two tapers finished by using a special guide or control plate. Not only was it necessary to maintain the tapers exactly correct, but a sharp edge was required at the junction of the tapers. It was also necessary to maintain an approximate relation between this edge and the face of the work. The control plate is utilized for giving the wheel its proper shape, as well as for guiding the wheel when grinding.

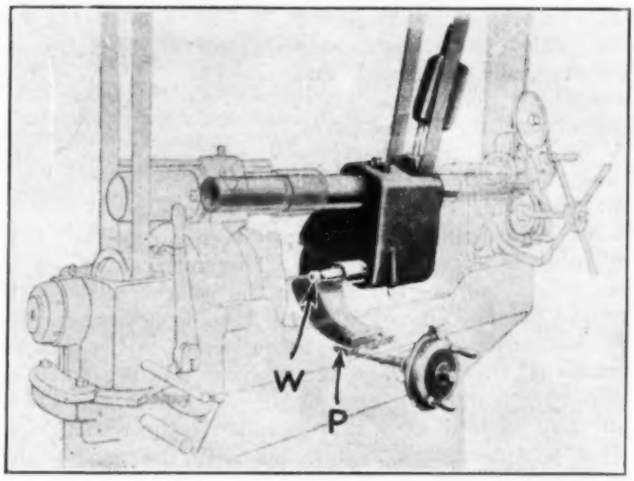

FIG. 1. ARRANGEMENT OF BRYANT WHEELSLIDE CONTROL

As the grinding wheel wears down, the relation of its surfaces changes slightly, and this, of course, shows up on the surface ground. In the piece under consideration, the wearing of the wheel would cause a variation in the distance of the junction of the tapers from the face of the work, if no adjustment were provided. To furnish a means of correction for wheel wear, a longitudinal adjustment has been provided for the follower on the end of the crossfeed screw. The movement of this follower is controlled through bevel gears by a small handwheel at the front of the machine.

In order to maintain the proper shape of hole, as well as to give lasting qualities, particular attention must be paid to the shape of the follower. From the figure it is evident how it is possible to give a sharp edge at the junction of the tapers. The plate moving on the surface of the follower causes the wheel to grind one taper. When the steeper surface of the plate strikes the follower, the wheel immediately starts to grind the corresponding angle. When truing the wheel, the wheelslide is near the right end of its stroke and hence the guide for truing the wheel is furnished at the left end of the control plate.

Drawing dies of various designs can be ground to good advantage by this method. The layout in Fig. 4 shows a die with a hole having two straight and one taper surface finished by traversing the wheel. This

does not vary greatly from the work shown in the previous figure.

The majority of dies are curved, similar to that shown in Fig. 5. In laying out control plate for this shape, it is necessary to figure on the proper shape of the grinding wheel periphery, as well as the shape of the control-plate follower. The shape of the wheel is determined by the nature of the work. Often a true radius can be used to advantage. In this instance a radial truing device was used to dress the grinding wheel. The control plate follower was given a $\frac{1}{16}$-in. radius on the contact point. To grind the hole the wheel was automatically traversed, and guided by the formed plate, it generated the desired curve. A very good finish was obtained by using a slow speed for traversing the wheel across the work.

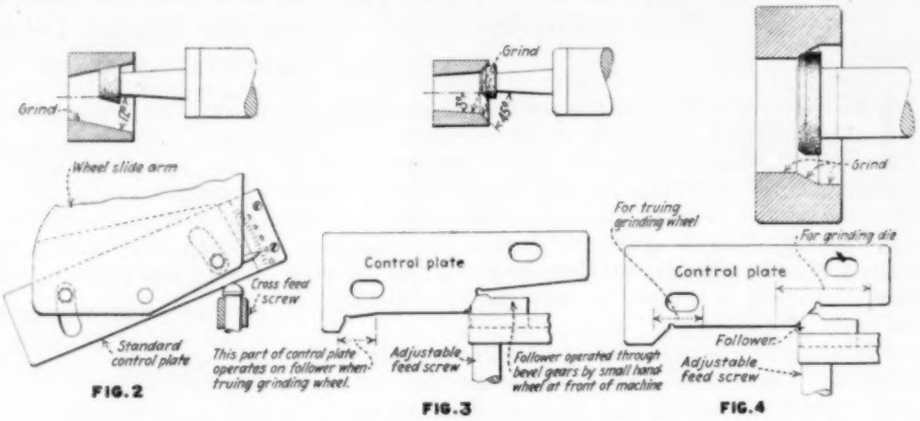

FIG. 2. POSITION OF CONTROL PLATE FOR TAPER GRINDING. FIG. 3. CONTROL PLATE FOR GRINDING A COMBINATION OF TAPERS. FIG. 4. TAPERED DRAWING DIE

An interesting example of irregular-shaped hole grinding is shown in Fig. 6. The saucepan shown is not bored, but is ground from the rough casting. Of course, precision is not required, it being desired merely to clean the surface. The castings come to the grinder somewhat distorted, and the problem was presented of removing a uniform amount of stock from the whole surface, instead of grinding a perfectly round hole. This was necessary as thin spots in the pans would be very objectionable.

For this job, the standard crossfeed screw was used, instead of the adjustable feed screw already referred to. By inserting a spring of proper tension back of the follower in the feed screw, the wheel was caused to follow the surface of the casting, removing just enough stock to give a smooth surface and maintain the uniform thickness of the original casting. The bottom surface was face ground with the same wheel that ground the sides.

Before starting to lay out special control plates, it is best when possible to place the work in its proper position in the chuck and observe the position of the feed screw on the control plate when the grinding wheel is through the work. This shows the distance between the center lines of the feed screw and the pivot dowel in the control plate, and gives the starting point in making the cut on the control plate.

On account of the fact that the grinding is done on the back side of the work, and also that the slide box, grinding wheel and control plate move while the feed screw remains stationary, the curve to be ground is drawn in a reverse position in order to lay out the curve on the control plate, as can be seen by referring to the previous figures. Since the slide box swings about the axis of the slide bar and since the control plate is below the grinding wheel, the cut on the control plate must be deeper than the curve of the work by the ratio of the radius of the plate to that of the wheel about the bar.

In Fig. 7 is shown a section of a wheel with a radius D. As the wheel wears away, it will take a shape on its edge from the part ground. This shape should in the design be assumed from the work as nearly as possible, and the wheel should be kept trued to maintain it.

The first step in the layout will be to draw in reverse position the curve to be ground. Then with the radius that is assumed on the wheel, work back to the curve that will be taken by the center of this radius, as shown by curve A. With this curve A, and using the proportional scale for the particular machine under consideration, lay out a curve for the control plate, as shown at B. This curve B would be the true curve of the control plate if the follower were a point. The follower, however, having a $\frac{1}{4}$-in. ball point, it is necessary to use a $\frac{1}{4}$-in. radius, and work from curve B to curve C, which is the curve of the control plate desired.

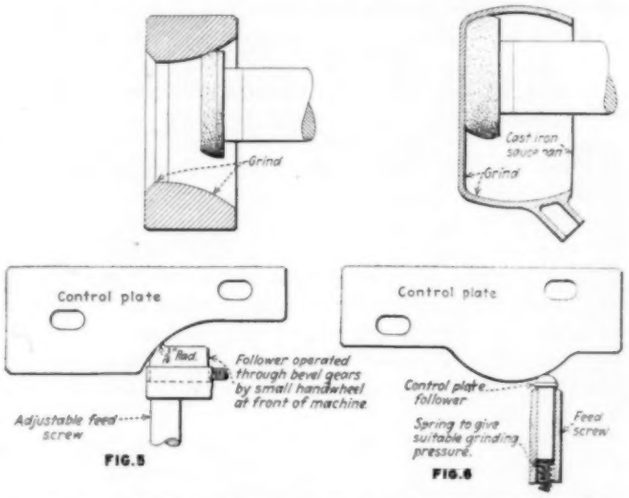

FIG. 5. CURVED DRAWING DIE. FIG. 6. COMBINED INTERNAL-CURVE AND FACE GRINDING

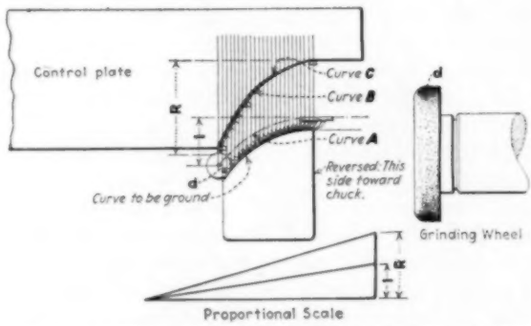

FIG. 7. LAYING OUT A CURVED CONTROL PLATE

MODERN PRODUCTION METHODS

By
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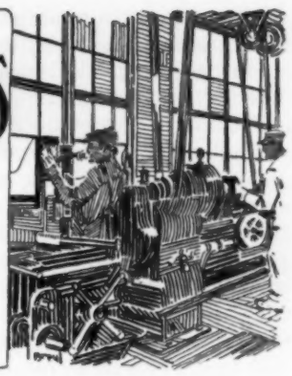


XXII. The Fundamentals of Correct Time Study

The Various Uses of Time Studies — Attitude of the Workman — Some General Rules for the Time Study Observer

TIME STUDIES are commonly thought of only as a guide in setting piece rates. Certainly that is the principal use to which they are put, but those concerns which have dug deep into the science of management realize that this is but one of their many uses. Frequently there are conditions which prevent the adoption of piece rates on work which is otherwise admirably fitted to that method of payment. That should not deter the management from profiting by the betterments which accurate time studies often show.

The wide scope of these betterments is indicated by the following list. Each one has to my knowledge been achieved in many machine shops. Time studies, then, may be used to: (1) Set just standards of production; (2) determine the most efficient size of gang; (3) detect the inefficient use of machines; (4) indicate that a present operation should be subdivided; (5) indicate that two or more of the present operations should be combined; (6) determine the efficiency of supplies and tools; (7) show whether new machines would be more economical; (8) standardize the best shop practice; (9) determine the best location of work and tools; (10) show how fatigue may be reduced; (11) improve the design of tools, jigs and fixtures; (12) detect improper handling in previous operations; (13) indicate the possibility of using wage incentives; (14) set piece rates; (15) determine the best arrangement of machines; (16) get equipment into balance; (17) test the fitness of the man to the work; (18) show up faulty planning and management.

When one realizes the many betterments to which time studies may be put, it becomes apparent that the greatest care is warranted in getting accurate studies. It would be a dangerously broad statement, perhaps, to say that most time studies are seriously inaccurate; yet I have seen so much labor trouble and restriction of production traceable to this fault that I have come to believe that accuracy is rare. Inequitable piece rates set upon inaccurate time studies act as an incentive to soldiering rather than to production.

The workers themselves are usually the first ones in a plant to realize that rates are carelessly set. Too high a rate restricts production, for experience has taught the workers that a hastily set rate will be just as hastily cut, if they show it up by making high earnings on it. Rates that are too low stir up discontent and stimulate floating.

Just recently, we were asked to help a manufacturer iron out labor unrest in his plant. A few talks with individual workmen showed that they felt the piece rates to be unjust. We made more than a hundred test time studies among workers of the same grade and found a surprising range in the amount that could be earned by the same person on various jobs. One man had a job on a Tuesday at which, by working industriously, he could earn $2.85 a day; on Wednesday he had a job that would have paid him $8.46—if he had dared to work hard enough to earn it! And yet the management claimed that the rates had all been set on time studies and brought forth the alleged time studies in proof. They were far from being real studies; typical was the one which simply noted that Operation 3 on part L47AB had consumed 84 seconds when performed by a good workman. Without further study to see if the methods of performing the various sub-operations could be improved, and with no knowledge of the relative skill of the man, this was set as the standard.

That exemplifies the commonest fault in most time studies; which is to take an overall time. To be a study on which fair rates and constructive betterments can be based, each part of an operation must be segregated and studied. Anything less cannot, except by courtesy, be called a study. In fact, the taking of time studies, expecially in a machine shop requires a scientific approach. I do not mean that it requires a laboratory scientist and so is beyond the abilities of a foreman or even of a bright clerk. Nearly every shop contains a half dozen men who in a few weeks can be trained to take time correctly, but it *is* essential that they thoroughly understand the problems involved and be taught the scientific methods of making their observations and studies. It is my purpose to give in this series of papers the information that a student will need.

Theoretically, it would be possible to set rates with overall studies only. But this would require that we have in the shop a workman whose skill could be reckoned at 100 per cent, whose conscientiousness could be relied upon, and the detail of whose procedure could be reduced to the most efficient basis. Unfortunately, these conditions can rarely be obtained in conjunction. It is therefore necessary to develop the standard time per operation from the performance of such workmen as may be available.

Analysis shows that the time of the ordinary work-

man will vary from standard because of three reasons. First, the wrong tools, speeds and feeds may be used on an operation. If those already in use are improper, that fact will be readily apparent when the cutting time is isolated. After the correct tools, speeds and feeds are substituted, they can be timed.

Second, nearly every operator will throw in a few or many needless motions or activities. If the operation be analyzed in careful detail, those elements which are unnecessary and which therefore a highly skilled worker would omit can be omitted in the standard, even though they have persistently recurred in the observed operations; frequently, for instance, we will find that several operators take three cuts to remove a given amount of stock when the time studies show that two cuts should be sufficient. The time consumed in the third or superfluous cut is of course dropped from the standard.

Thirdly, no man will work at an absolutely uniform rate throughout all the stages of an operation, no matter how uniform his time for the complete operation may run. Therefore, if we take horizontal sections through a series of operations, we can build up a standard, from the sum of recurring minima in the progressive stages. As a case in point, suppose the task be "burring corners" on a small collar. The performances making up the operation may be: (1) Chucking the part; (2) picking up the scraper and breaking the corner; (3) removing the part from the chuck and returning it with the opposite side outward; (4) burring the second side; (5) removing the part from the chuck, laying it aside and picking up a new part.

Average Time the Standard

Every part must submit to all five of these performances on its way to completion. If the time on all of the above performances be taken separately and charted, it will be found that even if the overall times be uniform it takes the operator less time to chuck the part in some instances than it does in others. Again, we would very likely find that the burring time will vary appreciably not only for different collars, but for the two sides of a single collar. Never mind what causes the difference; it may be the material or it may be the workman. In building up a standard we pick out for each performance the lowest time that recurs with any frequency, and adopt it as the probable average of a 100 per cent workman—in other words, as a standard.

I have already said that taking the overall time of an operation cannot be relied upon to give an accurate standard. In the foregoing description of the three factors that enter into a standard it is apparent that the faults of the workmen can only be uncovered by taking detailed studies.

The only way that an operation can be properly studied is to break it up into its component performances and take times on each. It is a fundamental rule of scientists who are attacking a problem to break the complex problem up into its simplest elements; these simple problems can then be minutely studied and easily solved, and the complex problem is thus solved.

Therefore, the first step in making time studies is to analyze the operation into its recurring stages or "performances" which will be found with a little practice, to be easy. The "burr corners" operation on a small collar, given above, is typical. As an illustration of straight machine work, consider what must be done in broaching the keyway in a small gear. On each part the performances are found to be: (1) Pick up a new part from the table; (2) raise the part and lower it over the broach; (3) pick up the arbor and, fitting the slot over the broach, inset the arbor within the gear; (4) throw on the power and make a cut, meanwhile applying oil to the cutter from the oil can; (5) take part and arbor off the table and remove the arbor, with the other hand return the finished part to the conveyor and take therefrom another part and place it on the table; (6) shut off the power, as the broach by this time has reached the top of its stroke and clean the chips preparatory to mounting the new part. It will be found that the operator duplicates the above performance every time he broaches a keyway.

The time study man then lists these performances and secures ten sets of isolated times on each of them which will add up to a total time for the complete process of broaching a keyway. Then he notes the speed and feed, and if they are not correct makes the needed correction.

Next he will study each performance in turn to determine whether or not it contributed to the result. If it did not, it is eliminated in setting the standard. Finally, he studies the actual times for each performance and selects the lowest recurring figure as standard.

In analyzing an operation into its constituent performances, it is necessary to be guided by the complexity of the operation; the duration of the complete operation; the proportions of machine time and hand time; and the variation in design of the part and of other similar parts to which results of the study may be extended.

There may be any number of performances from three up; and the time of each performance may vary from a fraction of a second to several thousand seconds.

General Rules

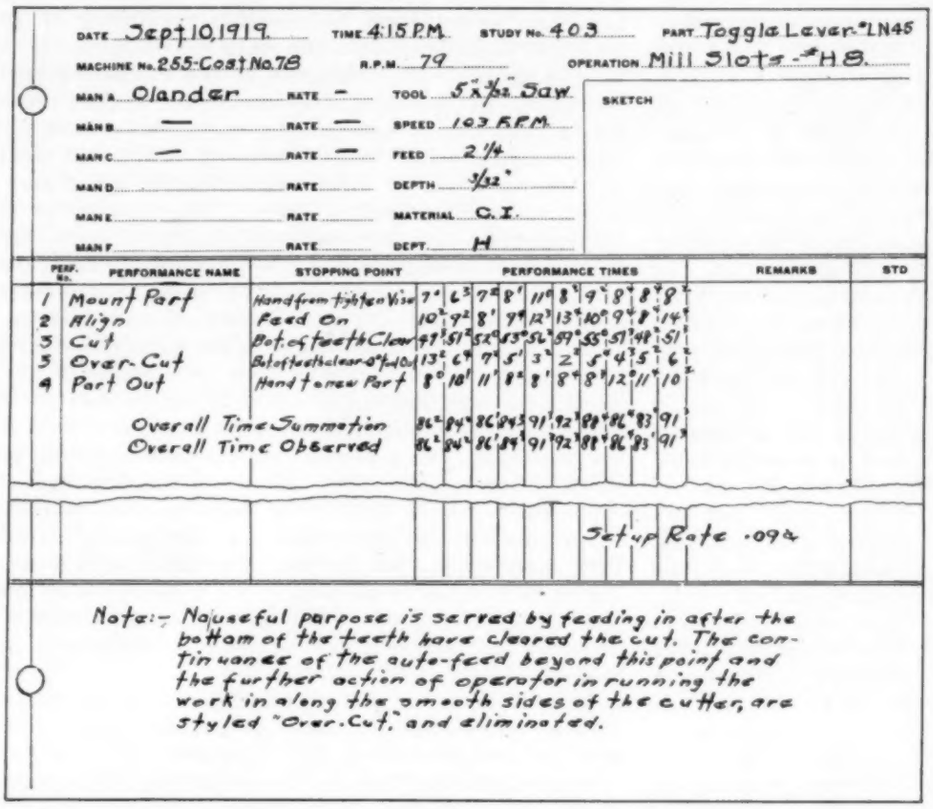
The general rules governing performances are that the longer an operation is in total, the longer is it permissible for the individual performances to be; and the more complex the operation becomes, the greater will be the number of performances. If the performance is a simple one requiring hand time throughout, the first two factors influencing the standard are commonly absent, and three or four performances may give sufficient detail to take care of the third factor.

The points of division between performances are indicated by the nature of the processes; and marked natural points of division should always be watched for even though the simplicity of the operation and its short duration might on the surface indicate that they could be ignored. Continuous cuts and other continuous process are not ordinarily divided; therefore, out of two operations requiring a given time, that which has the largest machine time concentrated in a few performances will ordinarily have the smaller total number of performances. An operation consisting of hand time throughout will ordinarily be divided into a greater number.

The design of the parts also has an effect upon the analysis. For instance, the original analysis of the performances involved in milling squares on shafts divided the body of the study into successive performances of "cut" and "turn part." The latter performance comprised lowering the table to the original position for beginning a cut and then turning the part to present

the next side for cutting. When we attempted, from this study, to derive standards for shafts of different sizes, we found that the variation in cutting time due to the variable length of the square could be readily calculated. But the time required to lower the table for new sizes of squares could not be deduced because the performances "turn part" consists of variable time for "lower table" plus a constant time for "turn part", each part regardless of its size, being turned through an angle of 90 degrees.

Accordingly, it was necessary to take another series of studies in which the original performance "turn part" was split up into two performances, "lower table" and "turn part." This simple illuustration shows how design affects the methods of study.


DATE Sept 10, 1919. TIME 4:15 P.M. STUDY No. 403 PART Toggle Lever-LN45
MACHINE No. 255-Cost No. 78 R.P.M. 79 OPERATION Mill Slot #-HB.
MAN A Olander RATE — TOOL 5"x 3/32" Saw
MAN B — RATE — SPEED 103 R.P.M.
MAN C — RATE — FEED 2 1/4
MAN D RATE DEPTH 3/32"
MAN E RATE MATERIAL C.I.
MAN F RATE DEPT. H
SKETCH

PERF. No.	PERFORMANCE NAME	STOPPING POINT	PERFORMANCE TIMES									REMARKS	STD
1	Mount Part	Hand from tightened Vise	7"	6.3	7.8	8'	11.9	8.9	9"	8.4	8.8	8.2	
2	Align	Feed On	10.4	7.2	8'	9.4	12.3	13.3	10.9	9.4	8.4	14.4	
3	Cut	Bot. of teeth Clear	49.3	51.2	52.6	53.3	54.2	59.6	55.6	51.4	48.2	51.2	
3	Over-Cut	Bot. of teeth clear 0"to 10"	13.2	6.4	7.4	5'	3.2	2.4	5.4	4.3	5.2	6.2	
4	Part Out	Hand to new Part	8.0	18'	11'	8.2	8'	8.4	8.3	12.0	11.4	10.2	
	Overall Time Summation		86.2	84.4	86.8	84.3	91.4	92.2	88.4	86.4	83.2	91.2	
	Overall Time Observed		86.2	84.4	86.8	84.3	91.4	92.2	88.4	86.4	83.2	91.2	

Setup Rate .09

Note:- No useful purpose is served by feeding in after the bottom of the teeth have cleared the cut. The continuance of the auto-feed beyond this point and the further action of operator in running the work in along the smooth sides of the cutter, are styled "Over-Cut" and eliminated.

FIG. 104. A TYPICAL TIME STUDY RECORD

The analysis which portrays an operation should be clean cut enough to make any performance interchangeable with the corresponding performance in another operation. This requires that each performance be rigidly defined not only as to what is done, but as to the precise moment when the performance ends. Accordingly, in the time study analysis as shown in Fig. 104, two columns are provided, the one headed performance, the other headed stopping point.

While the nature of the performance is given by the performance name, the points at which the stop watch is to be started and stopped are given by the stopping point. It is the stopping point and not the operation name which secures the desired interchangeability. It is, therefore, important that the stopping points should be outstanding events in the progress of the part and they should be so chosen that a variation in the operator's procedure cannot alter their essential character. Where possible, they should be not only visible but audible; an audible snap, such as that made when the automatic feed is tripped on a milling machine is ideal. Failing to find audible stopping points, instants of contact make good sharp stopping points. The recurrance of such stopping points as "hand to feed," "hand to wrench," "hand to new part" are entirely satisfactory and will be found much used in the studies which will be shown in later articles. Accuracy depends upon choosing stopping points which are sharply defined, instantaneous; and these so far as possible should be made standard. For instance, I recommend that all operations which precede machine feed cuts end at the moment when the feed is thrown on, and that the cuts themselves end when the feed is thrown off. These two points are always clearly recognizable. They limit the observed interval of the cutting operation to the time when the feed is on, and thereby facilitate the consideration of feed and speed in arriving at the standard, and also make it easy to compare corresponding studies. Similarly, the stopping of the last performance at "hand to new part" is recommended, since it gives evidence that the cycle of preformances covers a complete operation which may be multiplied indefinitely for any number of parts.

The manner of making an analysis will depend upon the complexity and duration of the operation. On short operations, the operator will almost always be found to work with a definite rhythm which the observer can readily sense and on which he can base his analysis. Merely observing such an operation on a few parts will enable him to write down all of the performances.

If the operations are long and complicated, the sequence of performances may be difficult to determine. In such a case, the observer will begin an operation at his standard point "hand to new part"; and thereafter follow it through for one part, setting down in detail each performance that the operator makes. The observer will then lay the record aside and proceed to record the performances on another part. It may be advisable to make a half dozen or so independent observations. Having accumulated the proper number of detailed records of performances, those performances which persistently recur in all of the operations will comprise the analysis, the others being thrown out as unessential. In using this method, it is necessary that the observer be very alert, and carry in his memory the stopping points which he has previously used on similar performances, so as to make the different performances interchangeable when the analysis is compiled. Here is one place where the advantage of a standard stopping point is apparent.

Rarely will an operator continue through a series of operations without interruptions of intermissions. On

a short operation, the operator is apt to seek relief from the strain of continuous application by taking short intermissions between parts. On a long operation the intermissions will naturally occur during the progress of the operation. In either event, this lost time must be eliminated from the study. The completed study should ordinarily contain only the time for productive performances.

However, unless the interruptions have clearly nothing to do with the processing, the observer should not attempt on snap judgment to eliminate them. If he is working from a fixed analysis, he should make foot notes showing where the lost time comes in and what it is used for; if he is recording the running story of the operation, he should describe just what occurred. This will enable him to study the matter after the analysis is complete and determine whether the times marked "lost" should be accounted for in the standard.

Lost time which is the result of fatigue or of attention given the tools is usually eliminated from the analysis for it is taken into account in another way which will be described in a future article. Sometimes, however, interruptions are accounted for in the standard as in a certain operation on a milling machine. In this operation, the analysis of the productive performances, showed that lost time which regularly occurred at the end of the cuts was unavoidable because it was due to the fact that the operator attended two machines at once.

Time is often lost by throwing in the feed in advance of contact between tool and part, and by permitting the feed to continue after the tool has cleared the cut. If the standard stopping points "feed on" and "feed off" are used, the time observed will not represent the actual cutting time. The way to handle this in a time study is to set the starting point of the cut at the instant of contact between tool and part, and the finish at the moment of clearance and show the two periods when the tool is "cutting the air" as separate performances which are eliminated from the standard. This is done in study 403, Fig. 104.

In a later article when the setting of an actual standard is described in detail, further instances of lost time and the methods of handling it will be discussed.

Having developed an alalysis of the operation into its standard sequence of performances, the next step is to observe the actual detailed times.

Two Kinds of Time Studies

Time studies are of two kinds, continuous and discontinuous, depending upon the method of taking the observations. Discontinuous times are the most accurate. Suppose an operation consists of ten performances. On the first part to be timed, the observer would time performances 1, 3, 5, 7 and 9. He would utilize the intervals consumed by performances 2, 4, 6, 8, and 10 to enter on his time study blank the times taken by the preceding performances. Then on the second piece to go through the operation he would time performances 2, 4, 6, 8 and 10 and write them down during performances 3, 5, 7, 9, 1. Thus the complete operation must be performed upon two parts in order to get one complete study. For this method a single hand stop watch may be used, reading the times to fifths of seconds. When the complete observation and its component performances are short, and there are plenty of parts to be processed, by all means use the method of discontinuous times in order to achieve accuracy. Then supplement them by taking several overall times for the complete operation in order to test the accuracy of the discontinuous times. Aside from its accuracy, the discontinuous method gives the observer plenty of time to watch the workman and take notes on his methods of work.

There are cases, however, when it seems best to take continuous times. For this method a watch with two independent second hands is required.

Continuous times are obtained by stopping the auxiliary hand at the first stopping point and recording its reading while the main second hand continues round. After the first performance has been recorded the auxiliary second hand is released, permitting it to snap into coincidence with the main second hand. It is stopped again at the conclusion of the succeeding performance. By this method we secure the elapsed times for our analysis by substracting the observed time for each stopping point, from the one succeeding it. Continuous times are of value when the number of parts to be observed is limited, since a complete series is obtained from each part instead of from two parts. The fact that the overall time is directly available from the continuous time observations makes possible a further saving of the observer's time. Where minute accuracy is not required this method enables complete studies to be made in one half the time of a discontinuous study. On very long operations this may be well worth while. On the other hand, when the analysis is worked up, continuous times demand considerable computation which discontinuous times save. A disadvantage of continuous times is that if the stopping point be carelessly observed the error will not only appear in the first performance but in the observation of the following performance as well. The observer will find use for both methods. The discontinuous method is recommended where it can be used, on account of its greater accuracy.

If two stop watches be manipulated at once, discontinuous times can be obtained, a complete series from a single part, but to do this accurately requires considerable skill and the practice is not recommended.

Authorities generally agree that ten complete observations is the minimum number if the standards are to be absolutely reliable. No number less than ten will give a proper separation of the extremes from the average. A study will rarely be found in which any random four or six operations will tell the same story that the complete series of ten does. On the other hand, ten is a number sufficiently large to reflect the variation in the usual case. For this reason the time study form is designed to accommodate ten, which will, of course, not prevent using additional sheets should circumstances seem to call for more than ten. When the operator is unusually dilatory, it may be necessary to take twenty or more readings. The point to be emphasized is that only the most exceptional circumstances could justify basing a standard on fewer than ten complete readings.

Note that if an analysis includes a number of repetitive and identical performances in a complete operation, time can often be saved by taking only ten of these performances, setting a standard from them and putting this standard into the whole as many times as necessary. In one instance I recall that twelve identical cuts were taken in each operation. Discontinuous times were taken on only ten cuts and the standard

secured from them was repeated twelve times in building up the total standard.

I have already indicated how we discount the effect of poor workmanship and intentional soldiering, by eliminating high performance figures and extra performances. Obviously, the most satisfactory studies are those in which such defensive tactics are not needed. But only too often we find that the workman bristles up at the first glimpse of a stopwatch. It is a tradition that stop-watches are invariably the forerunners of killing standards and unjust rates. While not always easy, we have found that it is usually possible to break down his opposition by man to man treatment and in the end secure his fullest co-operation. In the first place, criticism of his workmanship should be very sparingly made, if at all, and while simple constructive suggestions of an obvious sort can be given to him directly, in proportion as he is brought into the proper frame of mind to receive them, most changes in his procedure should be brought about through his foreman.

This emphasizes the importance of first securing the co-operation of the foreman, with whom the various operations should be discussed in detail. He will often be able to supply valuable information which the observe might otherwise miss. Questions from both operator and the foreman about the purpose, scope and method of time study work should be freely and frankly answered. Both should be allowed to see the study. It is surprising how intelligent an interest most workmen will take when they once see and understand the studies.

It is very important that all conditions affecting the performance should be noted down in the rough notes. These will ordinarily include any data bearing on the condition and state of repair of the machine, the condition of the belt, and so on. Nothing relevant should be left to memory; because while memory may perhaps be relied upon for making of the finished study, it cannot reliably decide a controversy that may grow out of the study some weeks after it is made. Rough notes should be carefully filed for reference.

The enthusiastic observer is usually tempted to recommend many changes which will obviously save time. Such savings may be made by changing the position of the conveyor, the manner of grasping the part, place in which the wrench is laid down, and so on. This is entirely a matter of proportion. Saving of five seconds per part brought about by an improved method of picking up the parts would be well worth while on a burring operation requiring only 30 seconds per part, whereas it would hardly repay the time spent in devising it on a milling operation requiring 1,000 seconds; and a saving of 50 seconds would be worth while on the 1,000 seconds operation, but not on an operation requiring 8,000 seconds. If an appreciable saving, and one within the limits of accuracy with which the standards are set, can be made by giving thought to such details, it should by all means be made.

Casting of Brass Ingots

The following paragraphs give a short summary of a paper presented by R. Genders at the annual autumn meeting of the Institute of Metals, held in Birmingham, Ala., on Sept. 21.

The failure of hollow-drawn articles, made from 70/30 brass rod, by splitting an expansion during manufacture or in service has generally been found to be due to the presence of non-metallic inclusions which originated in the cast ingot. In articles drawn from cupped disks, punched from rolled strip, the inclusions in the walls are circumferential in direction and of less effect on the wall strength.

The methods used in casting ingots of brass vary considerably in detail. Much consideration is given to the saving of rolling, and ingots are made in a correspondingly suitable form, those used for the making of rod commonly being very long and narrow.

Such forms are not particularly undesirable when the finished product is solid, but where a hollow article, subject to expanding stresses in use, is to be made, the avoidance of inclusions of foreign matter is vital, and the form of ingot requires considerable modification.

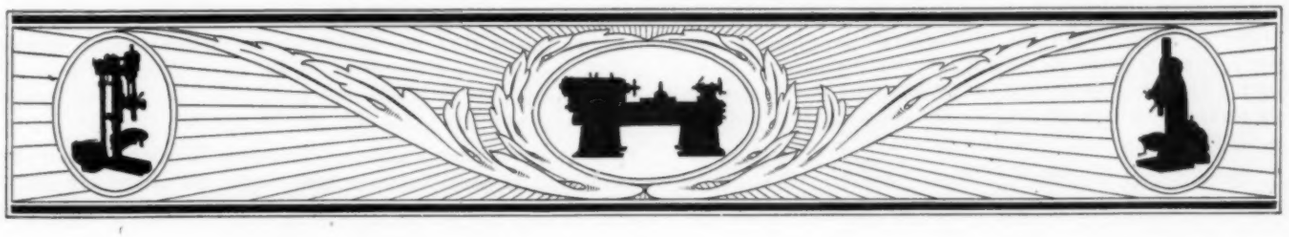
In experiments which were carried out to minimize the occurrence of non-metallic inclusions, a form of ingot was adopted whose length was not great in proportion to the cross sectional area. The ingots made were 3 in. square and 30 in. in length, as compared with the ingots 6 to 7 ft. in length and 1¾ in. square section in common use. Steel-making practice was followed in introducing a hot sinking head or "dozzle." The molten brass is poured through the dozzle, which is filled to the top. No pipe is formed in the ingot proper and additions of metal may be made at any time to the metal in the dozzle without risk of introducing defects into the ingot, any dross rising to the top of the still fluid head.

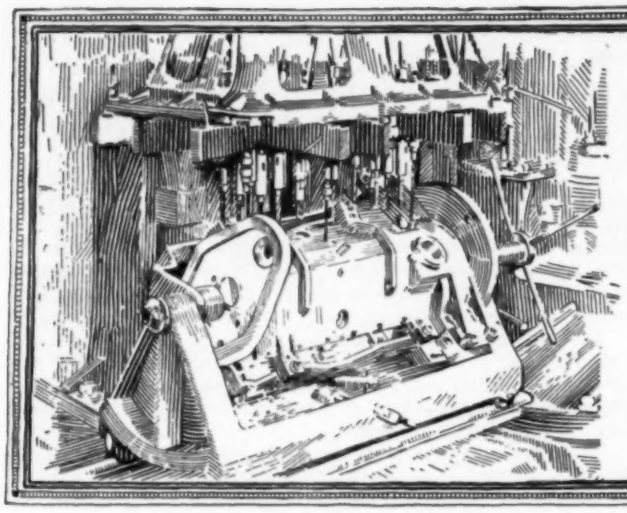
The molds were tapered, the top being enlarged by increasing amounts in successive experiments, and ingots were cast at the usual foundry speed. It was found that with a mold 3¼ in. square at the top, tapering to 3 in. at the bottom, no shrinkage cavities were formed and the ingot appeared to be practically perfect as regards soundness.

By those methods, failures which previously reached large percentages were reduced to practically nothing.

Automotive Engineers To Standardize Non-Ferrous Metals

The S. A. E. subdivision on wrought non-ferrous metal alloys has submitted for consideration specifications covering brass forging rod, brass spring wire, naval brass or, as it is sometimes called, Tobin bronze tubing and phosphor bronze spring wire. If these specifications are adopted by the society the S. A. E. Non-Ferrous Metal Specifications, of which there are now twenty-five, will cover a sufficiently wide range to permit automotive vehicle designers to select standard specifications for practically any automotive purpose for which non-ferrous metals are used. The specifications proposed cover, in addition to the compositions in percentage specified, the physical properties, appearance, dimensional tolerances and general information of interest to users.





Tool Engineering

By
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Turret and Engine Lathe Tooling—Factors To Be Considered—Types of Machines—Turret and Cross-Slide Tools—Holding Fixtures

IN DISCUSSING tooling methods for turret and engine lathes, we are taking up a subject radically different from any of those mentioned in the preceding articles. Both turret and engine lathes are used extensively in manufacturing and the tooling for these machines is of great importance in its application to high-class production methods. The average tool designer is usually somewhat "out of his element" when called upon to design fixtures and tools for turret lathes. It is of importance therefore to consider not only the design of tools and fixtures but also the construction and operation of the machines used for the work.

The possibilities of the machines from a production stand point are so great that a clear understanding of the class of work to which they are suited is one of the primary requirements when dealing with their their application to production processes. Many factors affect the methods used on this class of work so that it is advisable to specify some of these in order to understand their importance thoroughly.

In turret and engine lathe work we must always consider: (A) the work; (B) the method of holding, and (C) the cutting tools. By separating them in this manner it will be easier to understand various points in connection with each. For example, speaking of the work, it may be made from bar or cut-off stock, it may be a casting or a forging, regular or irregular, cylindrical, tapering or rectangular, or it may be heavy and cumbersome, or it may be light and fragile. These matters all have an effect on the method used to hold the work for the cutting operations. The design of the holding device is effected strongly by the size, shape, and general contour of the piece that is to be machined. The selection of the machine tool on which it is to be manufactured is also governed to some extent by the same items.

Standard types of cutting tools are used for certain kinds of work while for other varieties and classes of work special tool equipment is necessary. It will be seen from the foregoing that there are many points of importance which must be thought of in connection with the design of tools for turret lathe work.

In considering the method of handling any piece of work we must first select the machine, then determine the method of holding and finally design the tools which will do the work. In order to avoid confusion we will consider these matters separately; taking up first various methods of holding different kinds of work. The points of importance to be considered in the design of holding fixtures are quite varied and we will therefore separate them as far as possible and mention important matters connected with each condition.

(1) The work may be a rough casting or forging or it may have been partially finished in a previous operation. If it is a rough casting it may be of regular shape such that it can be held by the outside or the inside in some variety of chuck, either by means of regular or special jaws. Again the casting may be rough and regular in shape so that it can be held with special chuck jaws, but it may also be so long that it requires additional means of support, provision for which may be made either on the body of the chuck or by means of a supplementary fixture on the machine.

(2) The work may be irregular so that it can not be held by chuck jaws, in which case it will require a special fixture for holding. Occasionally fixtures of this kind require a great deal of care in their design, depending upon the nature of the work and its general shape as well as the machine operations that are to be performed upon it.

(3) If the work is thin and fragile, whether it is regular or irregular in shape and whether it is held by chuck jaws or in a special fixture, particular attention must be paid to the method of holding so that there is no possibility of distorting the work and causing inaccuracies in the finished product. Not only must the method of holding provide against this but also the action of the cutting tools must be considered so that the latter do not tend to distort the work during the process of machining.

(4) Work that has been finished in a previous operation may often require a special fixture in which suitable provision is made for locating from one or more important finished surfaces.

The foregoing points all have to do with the condition and general shape of the work but there are additional matters to be considered in connection with the

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design of holding devices which are applicable to practically all conditions. These points will be specified in detail later in this article.

Fig. 210 shows several examples of regular work suited to production on turret lathes. Examples *A* and *B* are made from bar stock with simple tooling of a standard nature. The work *C* is a casting of regular shape which can be held for machining in special chuck jaws and the work done in one operation as indicated by the *f* marks. The work shown at *D* can be held for the first operation in special chuck jaws while the second operation requires a locating device of special form. This piece requires two operations to complete the turret lathe work. The example *E* is a bronze casting having both an internal and external thread. The inside thread should be cut by means of a chasing attachment and the external thread with a self-opening die. Two operations would be required for this piece of work.

These examples of turret lathe work have been given in order to show the great variety which can be handled on machines of this kind. No attempt has been made to show irregular work which would require fixtures, as these will be taken up later in these articles.

Selection of Machines

In determining the type of machine most suited to a given piece of work it is necessary for the designer to have a general idea of the various types in common use. The diagrams shown in Fig. 211 are given in order to represent the operation features of several types of machines. All of these machines have somewhat different characteristics and for that reason the diagrams are made in such a way as to bring out the points of difference and to show their effect on the design of tools and fixtures.

The example *A* is a plain turret lathe having a cross slide *B* extending entirely across the bed and a turret *C* mounted on an adjustable longitudinal slide. Chucks or fixtures can be attached to the spindle and tools for cutting off or forming can be applied to the cross-slide. Tools are also applied to the turret. In the example *D* we have an all-geared head machine with a cross-slide *E* which does not extend across the bed of the machine, but which is provided with an indexing turret toolpost *F* in which a number of tools can be

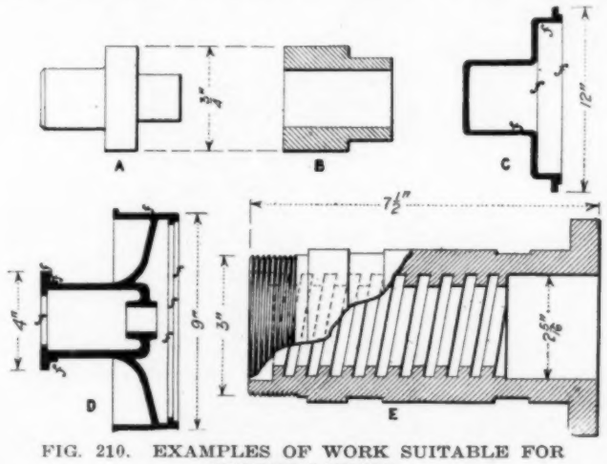


FIG. 210. EXAMPLES OF WORK SUITABLE FOR TURRET LATHES

placed to operate in sequence on the work. The turret *G* is mounted on a longitudinal slide and can be furnished with tools for various operations. The example at *H* represents several other types, one of which is provided with a cross-sliding head *K* which carries the spindle on which a chuck or fixture can be mounted. In this type of machine there is no regular cross-slide used and the facing operations on work are accomplished by the cross feeding movement of the head. Another

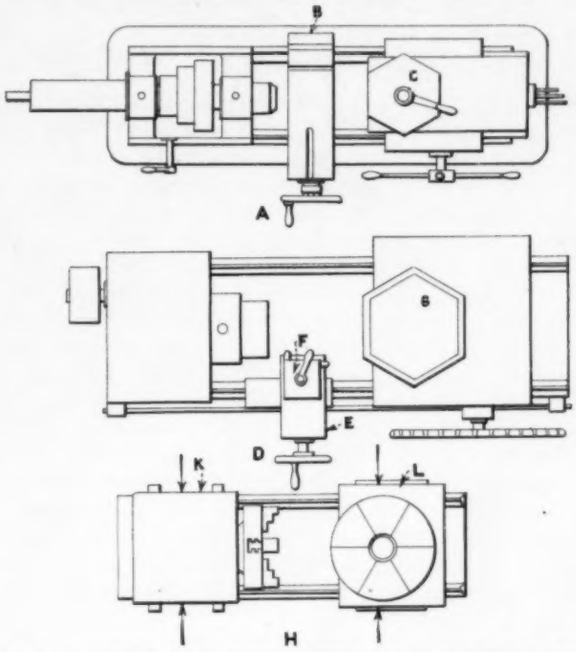


FIG. 211. REPRESENTATIVE TYPES OF TURRET LATHES

type of machine has a stationary head while the turret indicated at *L* has a cross feeding movement. This machine also has no cross-slide. These diagrams of the various types of machines in common use will make it evident to the designer that the application of tools to various turret machines is governed to a considerable extent by the type of machine to which the tools are applied. The movements of the turret, cross-slide, and head are somewhat different in several machines, and as a consequence the tools which are applied to them operate differently according to the particular machine selected.

In the selection of a machine for the work, judgment must be used in order that the tool equipment may be the most efficient that can be designed. The capacity of a given machine should always be ample to handle the work but it may be found that one type is more suited to certain operations than another; hence the machine selected should be one that will give the most satisfactory results.

Machine Reference Sheets

As there are so many different movements to be taken into consideration in the operation of a turret lathe, it is necessary to know the range of movement of cross-slide and turret in relation to the spindle. Also it is essential that the various machine dimensions which affect the design of tools should be readily accessible. It is undesirable to go into the shop and measure up every machine to which tools are to be applied, therefore data sheets giving complete information regarding machine sizes, ranges and capacities should be at hand for the tool designers ready reference.

Fig. 212 illustrates a data sheet for one certain size and variety of turret lathe. Attention is called to the various dimensions that are given on this sheet as they

will all be found of value when designing tools or fixtures. Sheets of this kind should be prepared for all production machines in the factory. They can be made on tracing cloth and blueprinted to form a data book for convenient reference. It is advisable to give the factory machine number on each of these sheets together with any other information that will be of help in locating a particular machine in the factory.

Application of Fixtures and Tools

In machining any piece of work on a turret or engine lathe we have first to provide a means of holding the work and next to furnish cutting tools which can be presented in sequence or combination to perform the various operations required. Fixtures are necessarily applied to the spindle of the machine while the cutting tools are used on the turret and cross-slide.

In the application of holding devices to the spindles of various machines the design of the spindle itself affects the fixture to some extent. Fig. 213 shows a number of types of spindles to which adapters, faceplates, chucks, collets and other holding devices can be applied. Any spindle which is designed to hold chucks or fixtures should be provided with a cylindrical portion for centering the chuck and a shoulder or surface for squaring it up in relation to the spindle. In nearly all cases the threaded portion provides a means of fastening the fixture and a cylindrical portion together with a squared up shoulder assists in truing up the fixture and taking the pull of the cutting tools.

In the example *A* the fixture screws on to the body of the spindle and is squared up by the shoulder *B* and centered by the outside diameter *C*. Example *D* is similar except that it has an additional bearing surface at *E*. Example *F* has a short threaded portion and two bearing surfaces at *G* and *H* in addition to the shoulder shown. The spindle shown at *K* is of a different variety as it is arranged so that the fixture screws into the female portion and obtains a bearing at *L* and also against the shoulder *M*.

In designing fixtures for use on turret lathe spindles it will be found good practice to fit the fixtures to an adapter such as that shown at *O* rather than to fit them to the spindle itself. The adapter is screwed directly to the spindle as indicated, and the fixture is made with a recess so that it will fit the flanged portion *P* on the adapter. By standardizing the adapters a great deal of fitting can be avoided so that the fixtures will be cheaper in first cost and they will also be interchangeable on different machines by simply changing the adapters. This is sometimes an advantage when there is a possibility of changing a fixture from one machine to another.

The example shown at *Q* is an adapter hood which is screwed to the spindle and so arranged that a special plug or other device can be fastened into it as indicated by the dotted lines at *R*. Other matters connected with the application of faceplates to the spindle will be taken up later in these articles. The various examples of spindles shown here are given in order to illustrate the differences between them and to show how they must necessarily affect any holding devices or fixtures which are applied to them.

Turrets on various machines are quite different in construction so that the tools which are applied to them must be designed to suit the particular type of turret on which they are to be used. We shall not attempt to show each style but will simply indicate those that are quite different in general design and which therefore require a different method of fastening and locating on the turret. Fig. 214 shows three types of turrets. The example *A* is of hexagon shape with six flat faces, in the center of which there is a hole for the stem of the tool and also four tapped holes on the face to assist in fastening it in place. In the example *B* the tools are set on the flat surface of the turret *C* and fastened in place by two or more screws as indicated at *D* and *E*. The location of the tool is assured by means of the slot *F*. Another type of turret is shown at *G*. This form is dove-tailed at *H* and *K* so that the tools can be fitted to this portion and clamped firmly in position.

It will be evident from the foregoing description of the various types of turrets that the construction of

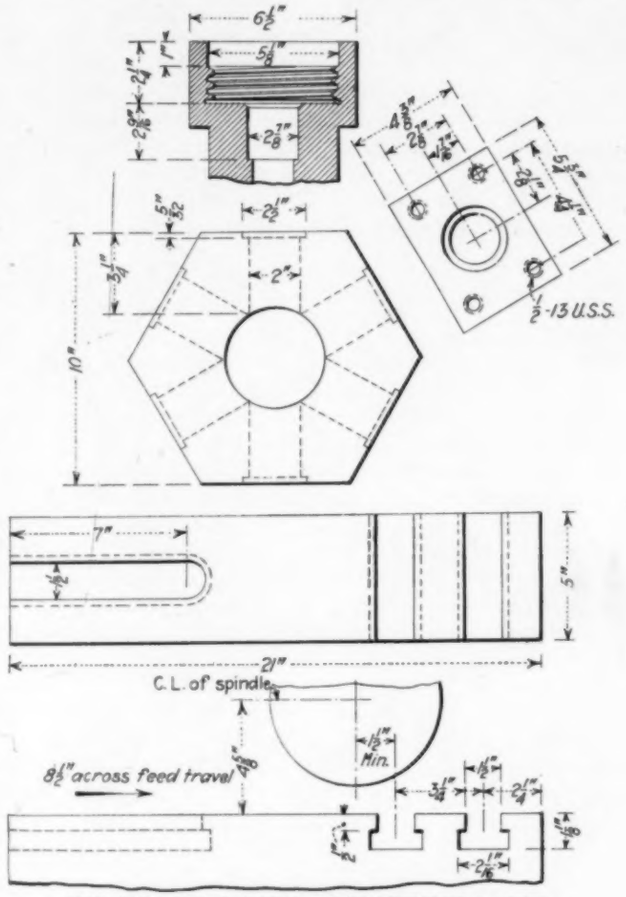


FIG. 212. DATA SHEET FOR TURRET LATHE

tools to be applied to them would be quite different on account of the different methods of fastening and locating used. There are some other types of turrets besides those shown but their general construction is not greatly different from these examples and therefore it is unnecessary to illustrate them.

Types of Cross-Slides

In designing cross-slide tools there are only two types of slides that need to be considered. One of these types, shown at *A* in Fig. 215, does not extend across the ways of the machine and the toolpost which is mounted on the slide is generally of the turret variety, having provision for three or four tools as indicated at *B*. The other type of cross-slide, shown at *C*, extends entirely across the ways of the machine and is so arranged that standard or special toolposts can be applied to it as indicated at *D* and *E*. This particular form of cross-

slide is in common use on operations requiring forming cuts and grooving and cutting-off operations. In case special tools are required the toolblocks can be designed to carry a group of tools at both the front and rear of the machine so that they will operate successively. The tools used for the cross-slide will be taken up separately in another part of these articles.

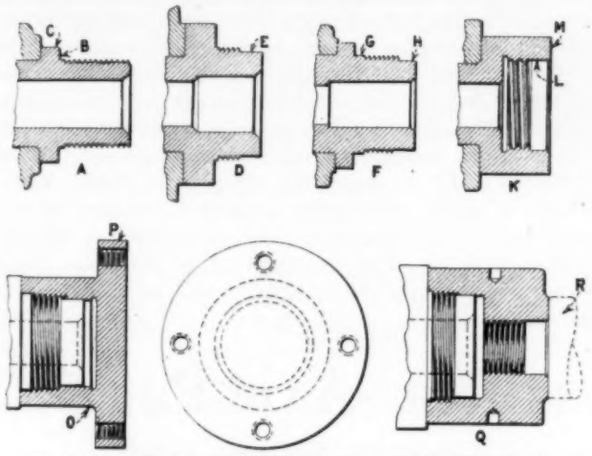


FIG. 213. TYPES OF TURRET LATHE SPINDLES

In pointing out the various factors of importance which must be considered in the design of holding devices for turret and engine lathe work, there are a number of matters which can be taken up to best advantage in the form of general notes. A number of these points are given herewith and more specific cases will be treated in their proper place.

(1) The production required, machine to be used, accuracy necessary in the product and material to be cut, must all be considered before attempting to design the holding fixture for any piece of work. The production required naturally affects the design of the fixture because a cheap fixture could be used when only a small number of pieces are to be machined, and no provision would need to be made for replacements in a fixture of

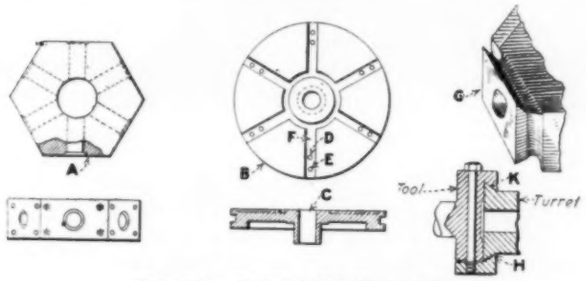


FIG. 214. TYPES OF TURRETS

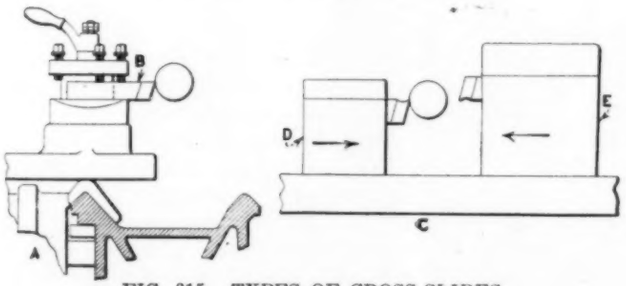


FIG. 215. TYPES OF CROSS-SLIDES

this kind. But for high production work the fixture would need to be provided with refinements to permit of replacements of worn parts and to insure the required accuracy under severe service. The machines used for a given piece of work must be selected carefully, keeping in mind the size of the work, the range required and the accuracy necessary. The machines available in the factory should be listed and a judicious selection made of the machines most suitable for the work. The accuracy required in the finished product makes it necessary not only to consider the condition and quality of the machine tool but also makes it essential to provide accurate fixtures. If a high degree of accuracy is needed provision must be made so that the fixture can be adjusted to run true with the spindle. This is particularly desirable when the work is produced in large quantities.

The material that is to be cut influences the design of fixtures to some extent, but the shape of the work, its size and general characteristics are of more importance. A piece of work which is irregular in shape and which has thin sections will require a very carefully designed fixture in order that there shall be no distortion of the work either while clamping or during the cutting action of the tools.

(2) Rigidity: Care must be taken that holding fixtures applied to the spindle of a machine are properly balanced so that they do not vibrate when in motion. It is sometimes necessary to use a counterpoise on fixtures which run at high speed. If the work that is to be held is long and the fixture used overhangs some distance beyond the end of the spindle, it may be found advisable to provide an "outboard bearing" in order to give the proper support. When anything of this kind is used it can be fitted to the ways of the lathe and adjusted so that it will greatly assist in preventing vibration in cases of an excessive overhang. In considering the matter of rigidity in connection with fixtures, the speed at which they will run should always be noted as it is evident that high-speed fixtures would need to be more carefully proportioned than those which run at slow speed.

(3) Location of work: If chuck jaws are used for either inside or outside holding on rough work, they must be carefully proportioned so that their bearing on the work will not be too long. Jaws should be substantial in section in order to withstand the stresses of cutting, particularly when they overhang from the chuck some distance. If fixtures are used for rough castings care must be taken to see that the work locates on only three fixed points. The matter of location of rough castings has been taken up in one of the previous articles. Selection of working points on which to locate castings must take into consideration the shape of the work that is being located and any parting lines, seams or fins on castings or forgings, in order that inaccurate work may not result from improper locating points. Occasionally pattern numbers on the outside of the casting cause trouble in location.

(4) Clamping Methods: Many methods and devices for clamping have been mentioned in previous articles and while the application to turret lathe fixtures may be slightly different from those which have been illustrated, the principles are the same in each case. It must be remembered however, that turret lathe fixtures revolve and therefore loose clamps should be avoided. Work should be supported as nearly opposite the clamps as possible in order that there will be no distortion of the work when clamping.

(5) Safety of the operator: As turret and lathe fixtures are applied to revolving spindles, care should be taken in the design to avoid the use of protruding

screws, clamps or lugs so that the operator will not be endangered by such things catching on his clothing. It is important also to pivot any swinging members or clamps in such a way that the accidental starting of the machine will not tend to break the fixture on account of these members striking the machine as they revolve.

(6) Lubrication of tools: On deep work when long holes are to be bored or when surfaces are to be machined which are not readily accessible, it may be necessary to provide a means of carrying the cutting lubricant to certain surfaces. In some instances a pipe can be carried through the spindle to discharge the lubricant in front of the cutting tools, depending on the centrifugal action to throw it out to all parts of the fixture. At other times openings in the fixture can be made to allow the lubricant to reach the various parts.

(7) Convenience of operation: As the turret lathe is a high production tool, attention should be paid to the convenience of setting and removing the work in order to make it as easy as possible for the operator. The clamps should be arranged so that they are convenient of access and easy to operate. A little attention paid to these points when designing a turret fixture will be appreciated by the operator and will be found to increase the production to a considerable extent. It is sometimes necessary to make sure that the work is properly positioned in the fixture while the clamps are being set up. On work that is difficult to locate, a device may be used in the turrent of the machine so that it will assist in locating and will help to hold the piece in an approximately true position while fastening the clamps.

There are a number of other specific points in connection with the design of fixtures, but as these cannot be handled under the head of general notes they will be treated specifically as the occasion demands. A number of cases will be cited during the progress of these articles and the important features will be mentioned in the description.

Machining Two Peerless Rear-Axle Parts

The Rear-Axle Housing, Its Machining and Assembly—Fixtures Used in Production of the Brake Spider

BY FRED H. COLVIN
Editor, *American Machinist*

THE Peerless rear-axle housing is of pressed steel, enlarged in the center to receive the differential and its carrier, and is suitably welded and reinforced at necessary points. There are twelve operations as follows:

Operation 1. Face and center both ends.
Operation 2. Drill six rivet holes and drill one hole for 1-in. pipe tap.
Operation 3. Press two collars in place.
Operation 4. Drill six rivet holes in collars.
Operation 5. Drive six rivets and tap for 1-in. pipe.
Operation 6. Straighten.
Operation 7. Grind taper ends.
Operation 8. Mill both faces.
Operation 9. Disk-grind both faces.
Operation 10. Drill twenty holes for $\frac{7}{16}$ x 14 tap and two holes for $\frac{1}{2}$-in. tap.
Operation 11. Tap twenty-two holes.
Operation 12. Final Inspection.

The first operation is performed in the fixture shown in Fig. 1. The fixture is mounted on the carriage of a plain engine lathe and is indexed so as to alternately present the ends of the housing to the inserted tooth chamfering cutter held in the lathe spindle. The housing is positioned by the hole in its center and is clamped at that point and at both ends, the fixture being so designed as to allow the work to be easily handled in and out of the machine and at the same time to be held firmly and correctly while in place.

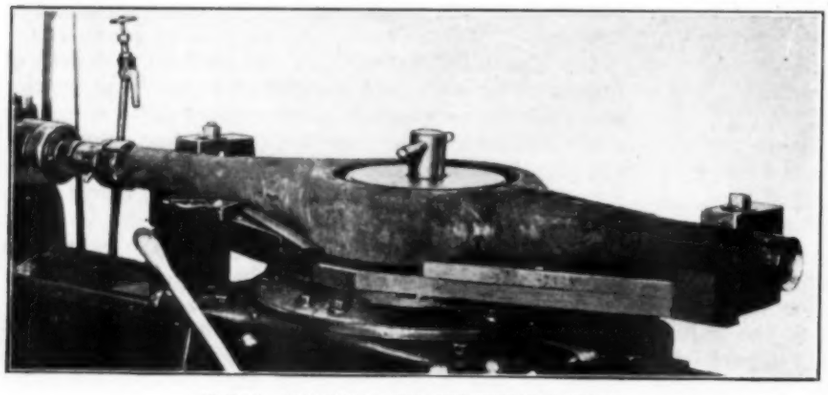


FIG. 1. FACING AND CENTERING ENDS

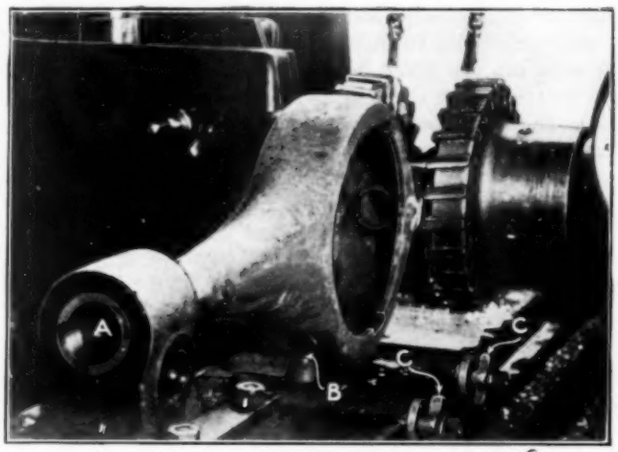


FIG. 2. MILLING BOTH SIDES OF HOUSING

When operations 2 to 7 have been performed the housing goes to the double-end Lucas boring machine, shown in Fig. 2, where the sides are milled as can be seen. The housing is held by the ends that have been previously finished as at *A* and is also supported under the center at *B*. The supporting pins at *B* are controlled by the knobs *C* and *C* so as to insure steadiness under the thrust of the two milling cutters, which work simultaneously.

After inspection, the housings go to the assembling department, where the combined brake spider and spring pad are forced in place as in Fig. 3. Here the housing is clamped at *A* while the assembled brake spider is forced over the finished ends by means of the hydraulic ram *B*. The guide *C*, which is pivoted by a cross-shaft, makes it easy to locate the spider by means of the spring pads and locates

them both in line so as to insure even action of the springs on both sides of the car.

Leaving this department the axles go for further assembly to the department shown in Fig. 4, where they are slid along substantial assembling stands which are of a convenient height and here the brake bands and other attachments are put in place. Here too, are the rear axles as can be seen in the box under the first assembling bench. After the brake bands and the differential carrier are put in place, together with the cover on the back the rear axle is ready to go on its way toward the final assembly.

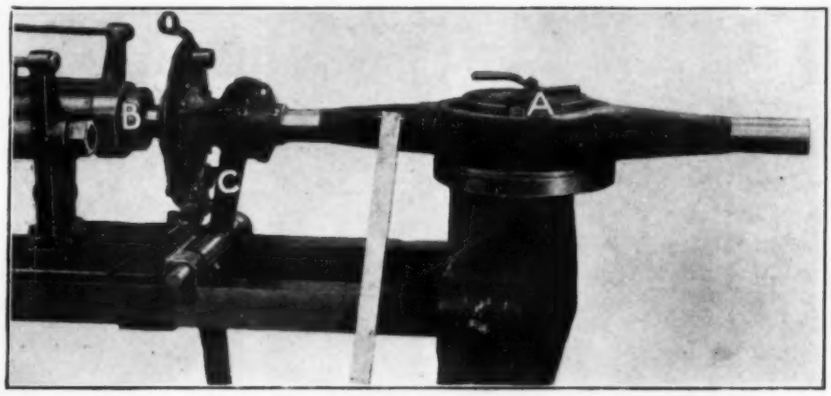


FIG. 3. FORCING ON THE BRAKE SPIDER

The brake spiders with their spring pads are made of malleable iron and are both right- and left-handed. While there is considerable work on them only eleven operations are necessary, including the inspection. The sequence of operations is as follows:

Operation 1. Bore, face flange and tap.
Operation 2. Finish bore taper hole and chamfer.
Operation 3. **Mill spring pads.**
Operation 4. Drill thirteen holes.
Operation 5. Drill eleven holes.
Operation 6. Drill five holes.
Operation 7. Spot-face four holes.
Operation 8. Drill two tap holes.
Operation 9. Ream taper hole.
Operation 10. Tap two holes.
Operation 11. Final Inspection.

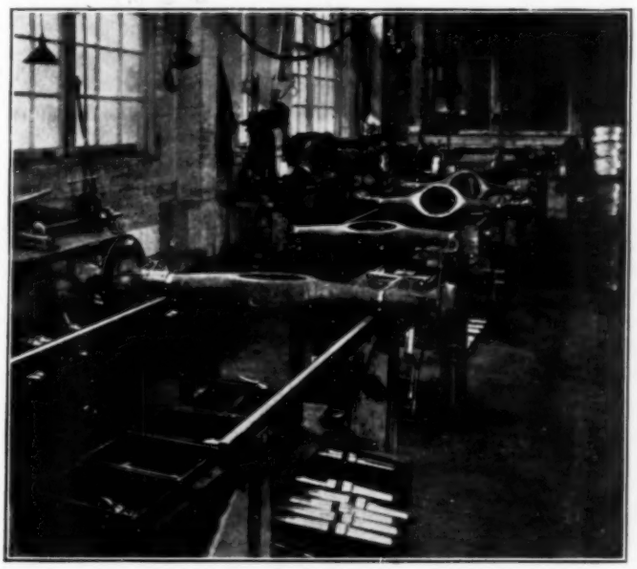


FIG. 4. ASSEMBLING THE REAR AXLES.

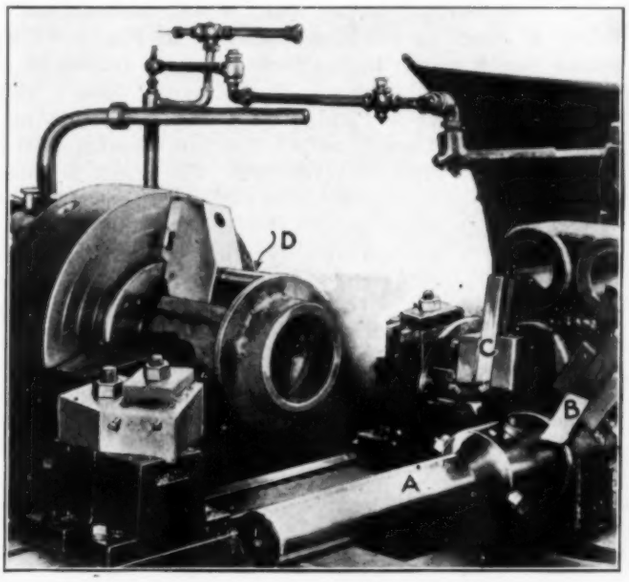


FIG. 5. BORING AND FACING BRAKE SPIDER

FIG. 6. FINISHED BORING AND CHAMFERING.

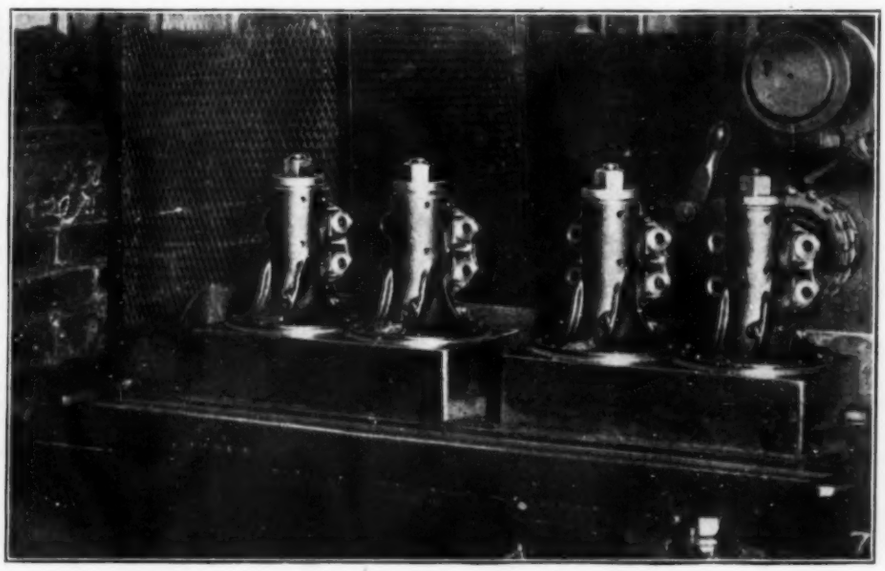


FIG. 7. MILLING THE SPRING PADS

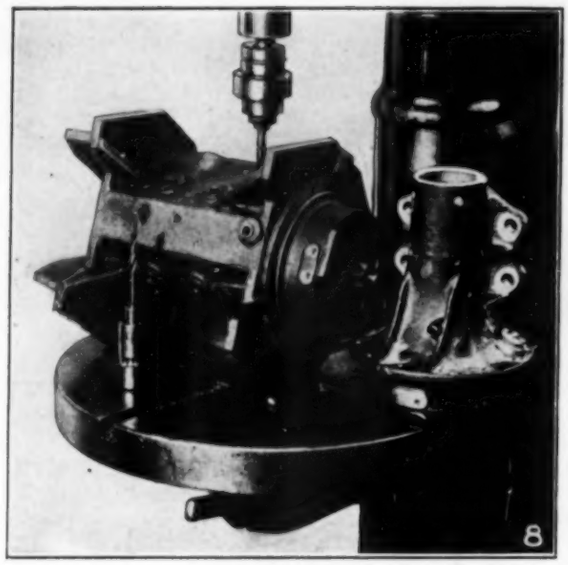


FIG. 8. DRILLING ANGULAR HOLES.

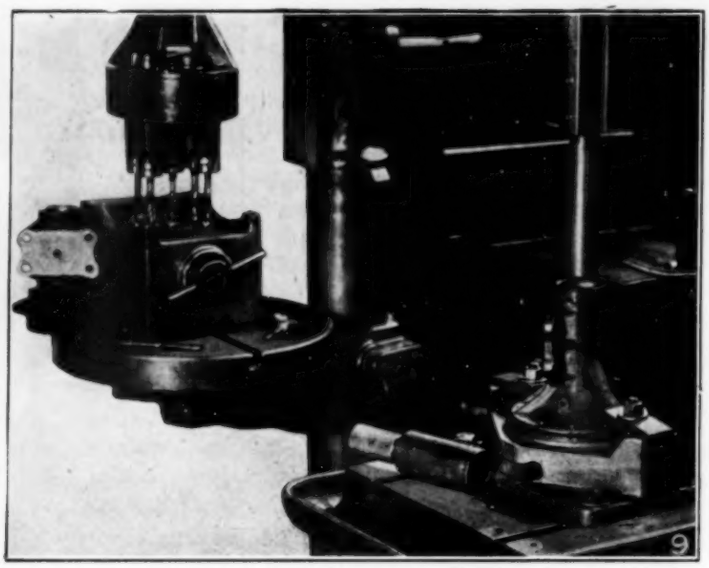


FIG. 9. DRILLING SPRING PAD AND REAMING SPIDER

The first boring, facing and tapping is done on a Potter & Johnston machine as shown in Fig. 5. The boring bar *A* shown in the foreground, is guided by a bushing to insure steadiness of the boring tools. The cross-slide is used in facing and some of the turning, while the two cutters *B* and *C*, substantially supported on the turret, finish the turning. The work is supported by internal guides, so as to insure concentricity and reduce the strain on the chuck. Another interesting feature is the use of long studs projecting from the jaws for reaching the back side of the flange. One of these is shown at *D*, each of the other jaws being similarly provided.

The finish boring, including the taper hole and the chamfering is done on a Foote-Burt drilling machine, as shown in Fig. 6. This view shows how the fixture locates the spider by its flange and holds it by means of the two straps shown.

Milling the Spring Seat

The milling of the spring seat or pad is accomplished on a Cincinnati knee type milling machine with fixtures which handle the work in pairs as shown in Fig. 7. These fixtures are simple blocks, raised high enough from the table to accommodate the projection on the end of the work and are cored for lightness. They are simple fixtures and require no further explanation.

Fig. 8 shows an interesting "roll-over" drilling fixture which provides for drilling a number of holes at varying angles. By using quick change drill chucks, the two sizes of holes are readily secured. The angles on the flanges of the fixture make it easy to roll it from one position to the next.

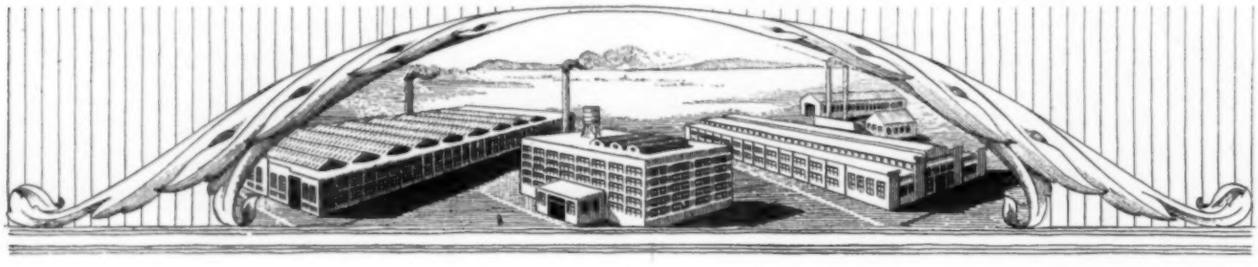
Drilling the spring pad and reaming the taper hole where the spider fits over the housing, are both shown in Fig. 9. The Hoefer five-spindle drilling head used, is attached to a Cincinnati drilling machine and completes drilling the pad at one operation.

Cut the Force or Reduce Working Hours?

By W. Burr Bennett

On page 375 of the *American Machinist* Mr. Forbes makes some observations that to the writer's mind are very much to the point and entirely coincides with our own experience. Especially is this true with regard to the last part of the article.

We have been running full time since Jan. 1st, 1921, chiefly by making persistent efforts to acquire business, and it is also our experience that we have fewer applicants for employment than during either the war or "boom" times. In fact we have had to advertise to get men at all and our records show only ten voluntary applications for machine operators, machinists or toolmakers since the first of this year. The daily press tells us that there are something like 500,000 men out of work but we haven't seen any around looking for jobs. Possibly it needs a little cold weather to bring them in. And a little observation on the writer's part among some other factory managers shows the same results. We realize of course that the large industrial centers have plenty of men looking for jobs but in the smaller towns we don't get them. But we do notice and we cannot help from commenting on it, that the pool rooms and cigar store "hang outs" are well occupied. (We hold no brief for or against pool rooms or cigar stores, but make the point as an illustration that seemingly everyone still has plenty of wealth.)



Organization and Management of the Small Shop

VI. Value of Cost Records—What Profit Should Be Based Upon—Classification of Material and Labor Accounts—Overhead and What It Consists Of

By E. W. LEACH

I KNOW of one manufacturer who, when approached by a salesman of any kind, always asks as one of his first questions, "Why do *I* need that?" It makes no difference if the salesman is trying to put over a new adding machine, a set of books or an advertising campaign, the old stand-by question is never forgotten. That manufacturer has about 300 men in his plant under normal conditions, his products are varied, and the men work on a premium plan of payment. I can easily imagine that he said to himself a good many times, "Why do I need a cost system?" But the system now in use in his plant is complete without any unnecessary frills, and in October, 1920, when so many neighbors were retrenching considerably or even closing down for thirty days, his company experienced its largest month in sales in twelve years.

No doubt you in your small shop have asked yourself the same question, "Why do I need a cost system?" but the fact that you are small and susceptible to the sorts of negligence that characterize so many small shops is all the more important reason why you should know exactly what your products cost you. A great many small manufacturers say to themselves, "Well, my competitors' products average about $50 in selling price. Mine is really a little better, but I'll put it out at the same figure. They must be making lots of money at that rate, so I guess I will." I'm not going to waste any great amount of space or time combating such a foolish theory as that, but it is certainly unfortunate that business men should be led astray so often just because it seems to be so simple a way of apparently solving what might otherwise be a complicated problem.

Business at its best has the element of guesswork conspicuously present; and without a cost system a manufacturing business is a hit-or-miss proposition of the most haphazard sort, with most of the emphasis on the "miss."

What Profit Should Consist Of

Whatever may be the product you are manufacturing and whatever may be the special conditions or circumstances peculiar to your own business, you are engaged in that business for the same reason as anyone else—*to sell goods at a profit*. That profit is not determined by selling price, it is determined by *cost*. The proper procedure is to determine your *cost*, add a fair and reasonable *profit*, and let the selling price depend upon the first two considerations. And in order to determine your cost with any degree of accuracy at all, you must be guided by certain methods and follow some definite plan—you must have a *system*.

No one system could ever be designed that would fill the exact needs of two different plants. By reason of their very differences, the same forms could not be used in both shops, nor could the same rules of practise apply. I feel, therefore, that this article will accomplish most if I let theory share with practice to quite an extent, with the hope that I may be able to suggest certain principles from which you can decide what physical form a cost system for your shop must assume.

The cost of an article is divided usually into three parts—material, labor and overhead. The material cost includes the actual cost of the materials in that article; the labor cost includes the actual cost of the labor directly expanded in making that article; and the overhead includes the portion or percentage of the expenses of the business that should be charged against that article. Determining the cost of the material used in any certain part is a very simple matter. On the bill of materials shown in the previous article, for example, you can determine the cost of the castings from their weight and from the price per pound that you are paying for them. The cost of the steel parts you can determine by knowing how much steel is used in each part and knowing the cost per hundred pounds. Any other parts or materials can be priced from the invoices.

Price Versus Cost

However, the mere price you pay for these different materials may not be all of their cost to you. Even before you have done any work on the raw materials you may have hauled them from freight depots or from local warehouses to the shop in your truck, you may keep a man busy in your stockroom looking after the material after it arrives, or it may be in such quantities that is occupies a considerable amount of space in the shop, for which it really should pay "rent." All of those things cost you money, and that cost should be added to the cost of your material and included in the item you call your "Material Cost." Make a list of the expenses incurred in direct connection with your material before any actual labor is put upon it to transfer it into the finished product. If the cost of those expenses amounts to 5 per cent of the invoice costs of the materials, it will be worth considering separately. If it is not that large, it will be sufficient to let those expenses be included in your general overhead charge, even though that may really be an incorrect distribution of the expense.

Materials should be divided into two classifications; direct and indirect. Direct material is that which is actually used in the product itself; and it is direct material that we have been talking about. Indirect material includes such items as oils, waste, brooms, small tools and similar supplies that are used in the shop. The cost of indirect materials is a part of overhead expense and should be included in that item. Paint or enamel may be used on your machines or products, and because of that fact should be considered truthfully as direct materials.

However, it is difficult to say with accuracy just what the cost of the paint on a certain part may be, therefore practically everyone considers paint as indirect material and the labor of painting as indirect labor. Permanent materials such as machinery and equipment do not enter directly into the cost of your product because they represent an asset the same as your plant, and their increase is a part of your profits just as though you took those profits out in cash instead of letting them stay in the business in those forms.

There are different ways of figuring the cost of indirect materials each month. The most accurate, and therefore, the correct way is to compute the cost of the materials actually used during that month. This will necessitate use of some form of "Material Requisition" (Fig. 3). A material requisition is an order to deliver certain goods to the person presenting it. With this there is tied up a second form that we might call a "Purchase Requisition" (Fig. 4). A purchase requisition is a memorandum to the person who does the buying, indicating a need of certain materials or supplies.

A purchase requisition has certain virtues which make it one of the first forms a small shop should use. For one thing, it requires the person making the request to "put it in writing." Unless you are an exception, you are a very busy man and have any number of matters constantly on your mind, all of which demand their proper share of your attention. When Bill Jones stops you on your way through the shop and tells you they're all out of ⅜-in. drills, the chances are that you will have forgotten all about drills before you ever get to the office. Later, when the matter again comes to your attention and you want to make out some orders, you can't just remember with certainty whether it was ⅜- or ½-in., and Bill may not be sure of it himself either.

MATERIAL REQUISITION				NUMBER	
DELIVER TO				CHARGE TO	
QUANTITY	DESCRIPTION	PRICE		EXTENSION	
Date.....		Signed by.....			

FIG. 3. SAMPLE "MATERIAL REQUISITION" FORM

But if Bill Jones can make out a requisition for a half dozen ⅜-in. drills, give you the original and keep a duplicate copy for his own reference, *he* knows that *his* part of it has been taken care of, and *you* know the shop needs drills, That requisition is there to constantly remind you until they are ordered and *your* part of it is taken care of also. The purchase requisition shown is a bit different in one or two details from the stereotyped requisition form, and I believe it is especially a "small shop form" for several reasons.

Systematic Checking of Materials

In general, it is another "multi-purpose" form. I would recommend that it be made out in duplicate, one copy to be kept by the person issuing it, and one copy to be turned over to the person who will order the goods called for. The item "ordered" acts as an additional check for yourself and should be filled in by you at the proper time, so that you will have on the requisition a record showing that the goods have actually been ordered. The item "received" should be filled in when the goods arrive at the shop, and the requisition kept with the others until the invoice for the goods reaches you, when it should be pinned to the invoice for ready reference when the invoice comes up later for payment. When the goods are received and put into stock or given to the workman who issued the requisition, his copy should be given to you, so that any requisitions which any of the men may have at any time will represent goods they need that have not yet arrived at the shop.

If you plan to require written requisitions for materials issued, you will have to have some sort of stockroom with a man or boy in charge. Frankly, you will have to keep your materials under lock and key,

PURCHASE REQUISITION			NUMBER
WE NEED THE FOLLOWING:			
QUANTITY	ARTICLE		DATE WANTED
Ordered	Received	Signed ..... Date	

FIG. 4. SAMPLE "PURCHASE REQUISITION" FORM

or you might just as well figure the amount of their monthly use with an ouija board and expect accurate figures. There is hardly any occasion for making out but a single copy of a "Material Requisition," for the goods are delivered at once when the requisition is presented. If they are not (because of lack of those materials) the person in the stockroom should call your attention to the shortage by means of a purchase requisition. At the end of the month, instead of charging indirect materials with the entire half dozen ⅜-in. drills, you will charge that account with the cost of the number of those drills that have been given out, and so on with all your supplies.

The Indirect Materials Account

A less accurate way, but one that is much easier and quite satisfactory in many shops, is to figure the cost of the indirect materials bought during a certain month—or, to be strictly accurate perhaps I should say the cost of the materials *paid for* that month. That is the method the writer used in his first small shop, and it served the purpose adequately for some time. Whenever I listed a check, the amount of that check was charged to some one or more accounts, such as indirect materials, for example. Goods bought in February were paid for early in March, so in March when I made out my overhead report for February, I used the total sum charged to the indirect materials account during March.

INDIRECT LABOR CARD						NUMBER	
ACCOUNT	NAME OF ACCOUNT						
DATE	START	STOP	HOURS	START	STOP	HOURS	TOTAL
Workman			Total hours..... Rate per hour..... Amount.....				

FIG. 5. SAMPLE "INDIRECT LABOR CARD" FORM

That method, obviously, has one disadvantage that would condemn its use in large plants. If you bought a barrel of cutting compound, it would last you three or four months. It would hardly be fair, really, that all its cost should be charged into one month and not any

of it the other two or three months; but in some small shops there is not a large enough percentage of indirect materials stocked up for months ahead so that that phase of the cost distribution need be considered seriously.

Division of Labor Accounts

Labor, also, is of two kinds—direct and indirect, and you can readily understand the distinction. Direct labor is the labor actually put into making your machines. Indirect labor is sometimes called "non-productive labor," and includes wages paid to the superintendent or foreman, draftsman, stockkeeper, packers, shipping clerk, truck driver, errand boy, and similar employees. Indirect labor, like indirect materials, should be made a part of your overhead. If you are not interested in knowing the divisions of your indirect labor expense, it can be figured very easily.

When I had less than ten men on the shop payroll, I totaled each week the cost-per-job on all job cards turned in during that week, and substracted that amount from the payroll for the week. The different gave me the amount I had paid for indirect labor. This was really very accurate. Of course, this gave me all the indirect labor in one lump sum without analyzing it in detail. If you wish to do that, you can make up an "indirect labor card" (Fig. 5) very similar to a job card, on which the men record the time they spend on indirect work. These cards can be turned in at the end of the week and sorted according to the accounts charged. In this way, too, every minute of the men's time is recorded on some card; and there is a reaction from their knowing that you are keeping a complete record of everything that they do.

The methods for figuring and recording direct labor were discussed in the previous article, so that it would only be repetition to explain them here. Direct material cost plus direct labor cost gives what is usually grouped under the general term, the "Direct Cost." The actual cost to you of the finished part, however, must include something more—the overhead.

The Definition of "Overhead"

Overhead is an expense, or rather a summary of expenses. It is the expense incurred incidental to the manufacturing of a finished product. There is another type of expense that must be computed, and that is selling expense. Overhead expense must be added to the value placed on finished products in making up cost figures and inventories. Selling expense overhead cannot be included at that time because *that* value has not been added to the product until it has actually been sold. We are immediately concerned, therefore, only with manufacturing expense, or factory overhead.

Two important items to be included in your factory overhead have already been discussed—indirect labor and indirect materials. Some other expenses that are a part of factory overhead are repairs, maintainance, heat, light, power, taxes, rent, interest, insurance and depreciation. There may be still other items peculiar to your own business.

One good way to determine whether the cost of an item should be charged into factory overhead is to ask yourself this question, "Does the spending of this money add to the permanent value of my business?" Heat, power, indirect labor, all such items add nothing of a permanent nature to the value of your business. While they all contribute to your comfort and your success, they cannot show up on your financial statements. For instance, a broom that costs one dollar will quickly be used up and should therefore be charged into factory overhead through the indirect materials account.

Permanent additions to your building or your equipment, however, are quite different. A high-speed milling cutter, or a new concrete floor in part of your shop, is something that increases the total value of your tools or plant, and therefore should not be included in overhead.

In discussing factory overhead we must bear in mind that we are thinking of it only in connection with small shops. A discussion of departmental distribution is unnecssary, because the class of plants in which I am interested have no departments, the whole productive section being combined into one place, known as "the shop." So I shall waive the importance of distributing factory overhead among departments, believing that your purpose will be amply served by considering your overhead expense as a single total.

Compiling the Overhead Report

You will want to make out an overhead report each month (similar to the one shown in Table 5), partly because the month is the standard business unit of time, and partly because the various expenses in your overhead are usually paid each month. Overhead expense is usually compared with direct expense in terms of percentage, the direct expense including either the labor cost or the labor and material cost. In a previous article, an illustration of a factory order card showed the following in one corner of the card; "Note, overhead is figured on labor only."

TABLE 5. SAMPLE "OVERHEAD REPORT"

Office expense	$ 9.20
Indirect labor	142.78
Superintendence	90.00
Indirect materials	27.75
Light and power	19.62
Rent	50.00
Taxes	2.08
Interest on Notes	13.33
Depreciation on Equipment	37.50
Total	$392.26
Direct labor	896.02
Overhead expense	392.26
% Overhead	43.7
SELLING EXPENSE	
Office salaries	162.00
Office expense	0.20
Printing and advertising	73.50
Total	244.70
Cost of goods sold	1,328.09
Selling expense	244.70
% Selling Expense	18.5
Production cost per machine	6.356
Selling expense	1.176
Total cost per machine	7.532
Net selling price	12.00
Profit	4.468

The factory overhead expenses incurred in operating your shop will more likely be proportionate to the cost of the work that is performed on each part rather than to the weight in pounds of that part or the cost of the material of which it is made. As was explained earlier in the article, there are certain expenses incurred defintely on materials, and those expenses should be kept separately and their percentage of the total cost of all materials purchased, figured as an overhead all by

itself—a material burden, and should be added to the cost of the material whenever the cost is to be used in figuring the cost of the part or product. The other overhead expense, however, (which will be 90 per cent of the total) should be included in the general factory overhead. The total amount of such expenses should be figured each month as a percentage of the total direct labor, arrived at by totaling the job cards turned in for that month. This percentage is your overhead.

In the typical overhead report shown it is 43.7 per cent. The cost of a certain casting would then be figured as follows:

Material	.1450
Labor	.0848
Overhead (43.7%)	.0370
Total cost	.2668

Very nearly all of the items that enter into the overhead can easily be grouped into monthly amounts because they are paid for each month. Taxes are more often paid once a year. If that is your case, the amount you pay for taxes should be divided by twelve and that amount used on your monthly overhead report. Depreciation is simply the decrease in value of your plant and equipment, and how much it shall be figured in your overhead is something to be determined only by your own good judgment. It depends on the condition of your building and your machinery and tools, and on how long they will be serviceable. An average charge for depreciation of buildings is 5 per cent a year and of machinery, 10 per cent. Small tools, such as milling cutters, chucks, vises, etc. will not last as long as the machines themselves, and patterns (if wood) will last an even shorter period.

Remember that when including your overhead expense in the cost of your goods you are simply making the purchaser of your product pay those expenses, and if you leave out items that should be included, or if you make your overhead too low (in an apparent attempt to keep down costs) you are actually giving your customer a discount, because you, yourself, are paying for some of the expenses that really should be included in the purchase price of your product.

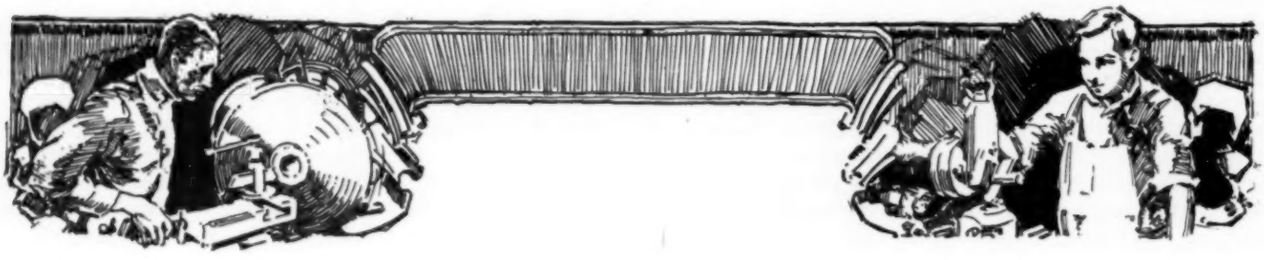
A cost system (any sort of record, for that matter) is of no value to you unless you make constant use of it. The principal function of a cost system is to determine the cost of your product. It is not sufficient to determine the cost of a certain machine, and then forget about that cost until a year later when the possibility of a change in price may occur to you. Such a practice is overlooking the greater purpose of your cost records—that of providing comparisons. You should compare the cost this month with the cost in previous months, not merely of each machine and each part, but of every single operation.

If certain jobs seem to be advancing in cost out of all proportion to the averages, it is time to inquire why. If the drill press operations have advanced 20 per cent in cost when operations on other machines have not advanced at all, it is time to investigate the drill press and its operator. If the milling machine operation costs are consistently lower, pass a part of the saving along to the man who created it for you by putting another 5 cents an hour into his pay envelope. You should also keep records or graphic charts to show monthly changes in the average wage per hour paid to your men compared with changes in cost of some machine taken for comparative purposes. With these two items you might also show on the same chart the changes in factory overhead and selling expense. Those records and charts will tell many an interesting story if you'll just let them; and in many cases they will act as a barometer and foretell some impending condition in time for you to take steps to prevent or counteract it.

If your competitor is able to sell products similar to your own for considerably less money than you sell your products for, it is probably not because he has a monopoly on material supply or because he makes slaves of his men and forces them to work long hours on short salaries. It is most likely because he is able to *save* in places where you do not. If you wish to decrease the cost of your product, your biggest possibilities lie along the lines of increased efficiency in manufacture through elimination of wastes and the lowering of unit costs through faster and better ways of doing things. A cost system, however simple it may appear to someone else, if it determines and records your costs and provides information that you can interpret into facts that are a help in increasing production efficiency and decreasing the very costs of which it is built—is worth its weight in gold. And that is mighty valuable.

Measurement of Ring Gages by Ball Method

Several rings were tested during the month at the Bureau of Standards by the ball method. The method used is a modification of that heretofore employed, which uses two balls the sum of whose diameter is slightly greater than the diameter of the ring. The new method consists of placing three balls of the same diameter in a ring 120 deg. apart with a fourth ball resting on them. This method gives substantially the same results as the two-ball method. In this connection there is need for a more accurate method of governing the contact pressure in measuring precision balls. The machine with a drop plug indicator on which this work is now done has sufficient friction in the anvil end to cause an uncertainty in the measurement of the contact pressure used. To provide a better means for measuring balls, and also for comparison of precision gage blocks by mechanical means, drawings of the millionth comparator used at the National Physical Laboratory, England, and by the Pratt & Whitney Co. have been secured and it is to be expected that a similar comparator will be constructed at the bureau.



Metal Cutting Tools—XV

By A. L. De Leeuw

(Continued from last week's issue.)

HOBS are made in various ways: With single or multiple thread, as shell or shank hobs, with parallel or with spiral gashes. Furthermore, the angle of spiral may vary, though all other elements of the hob and the elements of the gear to be cut may be the same.

In Fig. 245 a hob is shown at the moment when it begins to do work on the gear. It will have to penetrate a distance *a* before the centerline of the hob is on the same plane with the top of the gear; that is, before it begins to finish any one part of the gear. This

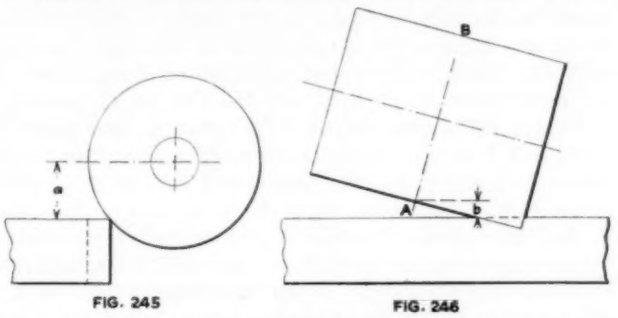


FIG. 245 FIG. 246

FIG. 245. HOB ABOUT TO ENTER WORK. FIG. 246. HOB SET AN AN ANGLE TO WORK AXIS

distance *a* is the approach and the time consumed to feed this distance may be considered as waste time. As the hob is shown in Fig. 245, its axis is supposed to be parallel to the face of the gear, which is a condition which we cannot realize in practice when cutting a spur gear.

Fig. 246 shows a hob set at an angle to the gear. This angle is supposed to be equal to the angle which the teeth around the hob make with its axis. In Fig. 245 it was the section *AB* which we considered. We see from Fig. 246 that the hob will have to travel a distance *b* in addition to the approach *a* before the hob begins to finish any part of the gear. The distance *b* depends on the spiral angle of the hob. With a multiple thread hob the spiral angle becomes greater than with a single thread hob, so that the distance *b* is also greater. If we have to cut gears (either a single gear or a stack of gears) with a total face *f*, then we would have to cut a total length of $f + a + b$ for a single thread hob, and a distance of $f + a + b_1$ for a multiple thread hob. We will readily see that $f + a + b_1$ is more than $f + a + b$, so that we have a greater loss with the multiple thread hob. However, the loss is never very great and where rapid production is the controlling factor multiple thread hobs should be used. As a matter of fact, they are largely used for roughing or for the production of gears where no extreme accuracy is required.

In the hobbing process indexing is not required, and as we know, indexing is one of the sources of error in gear cutting. Furthermore, a hob does not finish a single tooth and then proceed to do work on the next one, but it distributes its work around the entire circumference of the gear, so that there can never be local heating and consequent distortion of the blank. The spiral of the hob is made in the same manner as a screw thread is made, and screw threads can be produced with a very high degree of accuracy. Altogether, then, the hob has inherent qualities which will cause it to produce a very accurate gear. However, if we use a double, or in general a multiple, thread hob we eliminate some of these inherent good qualities. This was discussed at some length in article X.

If a spur gear is cut with a single thread hob and if the normal pitch of the thread is equal to the pitch of the gear, it becomes necessary to set the axis of the hob at an angle with the face of the gear, and this angle is the same as the spiral angle of the hob. If the gear to be cut were a helical gear it would be necessary to make this angle equal to the angle of the helix plus or minus the angle of the spiral of the hob. If the angle of the helix is great and we make the direction of the thread of the hob such that we have to add the two angles, then the hob will make a very large angle with the face of the gear. This will mean in the first place that we have a very large approach and in the second place that the hob will have to travel some distance below the face of the gear in order to finish up both sides of the teeth; and therefore that it would interfere with anything which might be directly below the gear. This happens when cutting herringbone gears; so that if herringbone gears must be cut with a large helix angle, a very wide groove must be

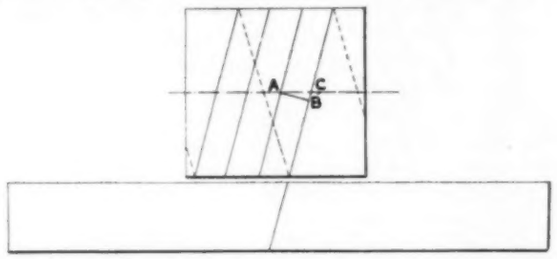


FIG. 248. MULTIPLE THREAD HOB FOR HELICAL GEARS

left between the two parts of the gear in order to allow them to clear the hob.

Besides all this, at the beginning and toward the end of the cut the cutting action takes place from only one side of a tooth; so that there is liable to be an offset or shoulder at a point where the hob begins to act on both sides of the teeth. This is shown in diagrammatic form in Fig. 247, where *AB* represents the axis of the hob at the beginning of the cut and A_1B_1 near the end; while the lines *XY* and X_1Y_1 represent the two sides of the tooth gap.

These difficulties in the use of a hob for herringbone gears and, for that matter, to a certain extent for all helical gears can be very neatly overcome by the use of multiple thread hobs. If, for instance, the angle of the gear teeth is 25 deg., all we have to do is to construct a hob of which the angle of the spiral is 25 deg., in which case we can place the hob parallel with the face of the gear. This condition is shown diagrammatically in Fig. 248. When using a hob in this manner it becomes necessary to select a diameter of hob which permits the application of this scheme. The spiral angle of the hob is determined by its diameter, by the number of threads, and the normal pitch. As the normal pitch and the number of threads are predetermined and as we want to obtain the same angle

as the angle of the helix, we must calculate the diameter. However, this is a simple matter, as the following example will show.

Angle of helix—25 deg.

Number of threads—4.

Normal pitch—6 diametral.

In Fig. 248 the line AB equals $3.1416 \div 6 = 0.5236$. The line AC equals $AB \times$ sec. 25 deg. $= 0.5236 \times 1.034 = 0.5414$.

The lead is therefore $4 \times 0.5414 = 2.1656$. In Fig. 249 the thread is developed. The line PQ is the circumference of the pitch circle of the hob, and PR is the lead, 2.1656; while the angle PQR is 25 deg. We find that the line $PQ = 2.1656 \times$ cotg. 25 deg. $= 4.644$; so that the pitch diameter of this hob would be 1.478. This is probably too small and, unless it should be possible to use a shank hob, we would have to make another trial with more threads in the hob, say six or eight. A hob used in this manner has, of course, the disadvantages of all multiple thread hobs, but there are many cases in which the required accuracy of the gear is not so exacting but that we would be permitted to use this method. There is another practical consideration against the use of such hobs. As long as we use a hob by setting it at the required angle, namely, the sum of the angles of the helix and the spiral of the hob, we produce a normal pitch in the gear equal to the normal pitch of the hob, and we can therefore use this hob for helical gears with any helix angle and also for spur gears. However, as soon as we use a hob in the manner shown in Fig. 248 we can only use it for helical gears with the particular angle for which the hob is calculated; though here again, we have some leeway, as we shall see. Using a hob in this manner we depend on the axial pitch and we reproduce this axial pitch in the gear to be cut. As soon as we turn this hob to any angle with the gear, we produce a new axial pitch. If we should wish to cut a gear with a helix angle of 24 deg. instead of 25, all we would need to do is merely set the hob to an angle of 1 deg., and we would again have the same normal pitch as we had cut in the gear with an angle of 25 deg. This shows that after all we can cut more than one angle of helix with the same hob, but this is only true to a very limited extent. The teeth of the hob have clearance and, in the nature of things, this clearance cannot be very great and if we tilt the hob to a certain angle, we very soon destroy part or all of that clearance.

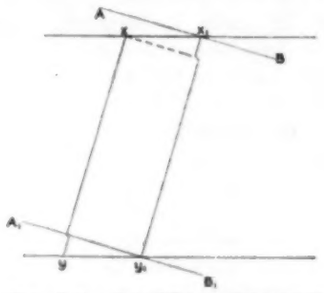


FIG. 247. DIAGRAM SHOWING OFFSETS AT BEGINNING OF CUTTING

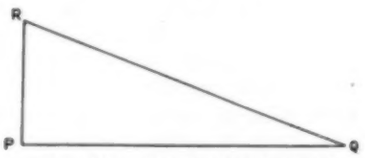


FIG. 249. DIAGRAM OF HOB CALCULATIONS

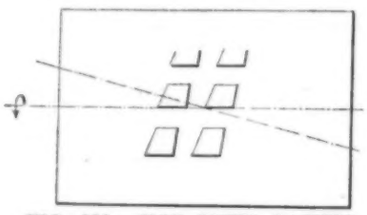


FIG. 252. HOB WITH GASHES PARALLEL TO AXIS

Fig. 250 shows a hob with spiral angle of 30 deg. The clearance of the individual teeth is 6 deg. The direction in which a tooth cuts is shown by arrow No. 1. It would seem at a first glance that the tooth has negative clearance on the right and an excessive amount of clearance on the left; and this would be true if the gear were stationary while the cut is being taken. However, the gear has a movement toward the right and this causes the cut to be in the direction of arrow No. 2. It is well that one should have a vivid picture of this thing in order to understand clearly the possibilities and limitations of the hobbing process.

Let us imagine a chisel being forced down in the direction of arrow No. 1 (see Fig. 251). It must split off all the material to the left of AB and it must push the rest of the piece to the right. If the piece is rigidly held, as it is supposed to be in a machine tool, the chisel itself must move toward the left. If it cannot do so, something will have to break, provided the machine is not stalled. If, however, the piece of work has a movement in the direction of arrow No. 2, the line CD will be the line along which the cut is taken and the tool may clear if the motion of the work in the direction of arrow No. 2 is sufficiently rapid as compared to the motion of the tool. The shaving removed will no longer be all the material to the left of AB, but the piece CDD_1C_1. This is exactly what happens when we apply the principle of the multiple thread hob to the cutting of helical gears.

A hob may be made with right- or left-hand thread. If made with right-hand thread and running right hand, it will have a tendency to pull the blank it is cutting; in other words, it would cause the blank to rotate in right-hand direction (looking at the top of the blank) and therefore that is the direction in which the blank should be driven by the machine. If the hob were made with left-hand spiral and were rotating in a right-hand direction, the direction of the blank would have to be left-hand. The directions referred to are, of course, relative only and depend on the way we look at hob and blank.

As to the cutting of a spur gear, the direction of the spiral has no effect; but when helical gears must be cut this direction of spiral must be taken into consideration. The effect has been mentioned before: namely, that the angle between the axis of the hob and the face of the gear is, in one case—angle of helix plus angle of hob spiral, and, in the other case, angle of helix minus angle of hob spiral.

If we want to cut a helical gear with 25-deg. helix angle we can reduce the angle to which we have to set the hob by making the spiral angle of the hob large and by giving it such a direction that we can set it to the difference of the two angles. By making the spiral angle 25 deg. we can even set the hob parallel to the face of the gear. But if we wish to cut a herringbone gear, one part of which, of course, has a right-hand and the other part a left-hand helix we will need two hobs; one with left-hand and the other with right-hand spiral angle, and we must use the left-hand hob for the right-hand helix and vice versa.

In the foregoing discussion it was taken for granted that the cutting face of the hob tooth was at right-angles to the direction of the spiral, which is the case with the ordinary spiral gashed hob. However, not all

hobs are made this way. Many hobs are made with the gashes parallel to the axis, as indicated in Fig. 252. The main advantage of this construction is obvious. It becomes much easier to regrind the hob. Its chief disadvantage lies in the fact that the hob acts as if it had negative rake on one side of the teeth. As a consequence it is liable to produce rough work.

To minimize this effect a hob of large diameter is required, because a large diameter means a small spiral angle, and this in its turn means a small angle between the axis of the hob and the face of the gear. However, large hobs are expensive, and for that reason a compromise is often made in the following manner:

The hob is made of a size which would naturally be required for depth of tooth, thickness of metal, size of bore, etc. But it is set in the machine at an angle smaller than the spiral angle. This will reduce the negative rake, but at the same time it generates a gear of which the pitch is different from the normal pitch of the hob. It is therefore necessary to make the hob of such a pitch that, when it is set at the prescribed angle, it will generate the desired pitch in the gear. Hobs made in this manner should be marked as to the angle to which they should be set in the hobbing machine.

From the foregoing it will be seen that the hob is a tool which lends itself to many wrinkles and kinks. A great part of the use of a hob is devoted to the making of very accurate gearing, and where that is the case, accuracy must be maintained at any cost; so that wrinkles and kinks no longer apply if they affect the accuracy even to the slightest degree. One of the sources of inaccuracy lies in the fact that a hob must be hardened before it can be used and that this hardening is liable to cause distortions of various kinds.

It is very apt to make the hob eccentric. It is also apt to make it longer or shorter, according to the nature of the steel used; and furthermore, this lengthening or shortening may not be even throughout the entire length of the tool. For these reasons it becomes impossible to use a hob for the very finest kind of work, unless it is finished after hardening. This is now generally done for the better classes of work. Though the first cost of such a hob is considerably greater than that of an unground hob it is doubtful if the total cost

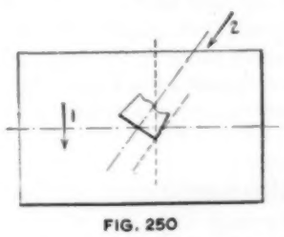


FIG. 250

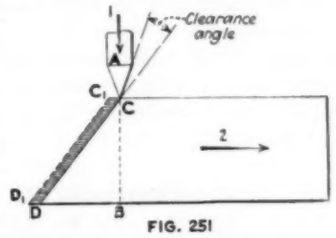


FIG. 251

FIG. 250. HOB WITH SPIRAL ANGLE OF 30 DEG. FIG. 251. CHISEL ACTION TO ILLUSTRATE HOB PRINCIPLE

of hob and work done is any greater for a ground than for an unground hob. The reason is that a ground hob will do more and faster work for one grinding than an unground hob. The matter of grinding a cutter all over in order to avoid the roughness and irregularity of outline of a milling tooth has been discussed before; the same reasoning applies to hobs. Nevertheless, there will always be a call for unground hobs, especially in cases where they are not used for quantity work, so that the first cost becomes important.

The matter of grinding hobs has been discussed in a general way and it was pointed out how necessary it is to locate a gage point from which to grind the hob. At the present time there is no machine in existence which will take care of this matter in a satisfactory way; but even if there were, it would not be possible

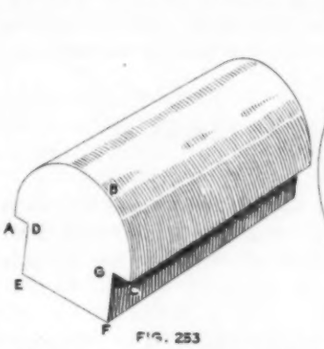


FIG. 253

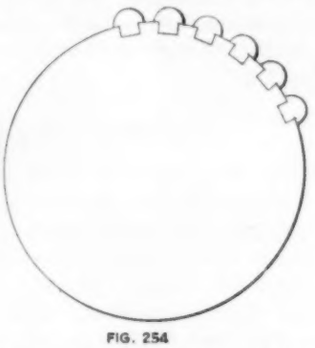


FIG. 254

FIG. 253. A PIECE OF WORK THAT CAN BE MACHINED BY HOBBING. FIG. 254. WORK SET UP ON DRUM FOR HOBBING

to grind the hob so that all its teeth are as they should be. The gage points can only be located on one single turn of the spiral. When this is done the hob can be ground so that that particular turn of the spiral is entirely correct and this turn should then be used for the finishing of the gear to be cut, while the other turns of the spiral should be used only for roughing.

In order to save first costs and also for the purpose of avoiding excessive width of groove between the two parts of a herringbone gear, hobs are sometimes used which are shorter than they should be for the perfect generation of a gear. So long as that part of the gear tooth which has an actual bearing is properly generated, this shortcoming does not cause any trouble. But if the hob is made too short, it is liable either to affect the bearing part of the tooth or else it may not round the top of the tooth sufficiently to avoid interference, so that one should not go too far with the shortening of the hob without first looking into the matter.

It should be noted that not all teeth of the hob do the same amount of work. It will be found after cutting a certain number of gears that one turn of the spiral is worn or dulled much more than the rest of the hob. As it becomes necessary to regrind the hob if even a single tooth is dulled too much, it is well to watch the dulling of the teeth very carefully and, if possible, shift the hob lengthwise so as to bring a new convolution into play for the heavier part of the work. In that manner the wear may be distributed over more teeth and the hob will cut more gears between grindings.

So far we have looked at the hob almost exclusively as a tool for the cutting of gears. However, it is equally adapted to the cutting of ratchets, sprockets, spline shafts, and other pieces with teeth or projections or depressions evenly spaced around a cylindrical body. As a matter of fact, spline shafts used in automobiles are generally made this way.

There is another class of work to which the hobbing process might be successfully applied. Where pieces of relatively considerable length must be form-milled, it might be possible to clamp these pieces around a drum and then apply the hobbing process to this drum with its pieces as if it were a gear or sprocket or spline shaft. If, for instance, pieces had to be made of

the shape shown in Fig. 253 they might be placed around a drum as shown in Fig. 254. Much more complicated shapes than that shown in Fig. 253 might be made that way, but there is one thing which should not be forgotten. Though it is possible to make the portion *ABC* by means of hobbing process, it is not possible to make the portion *DEFG* in that manner, because a hob cannot make a square corner such as *ADE*, although it is able to make a square corner such as *DEF*.

Conserving Steel Stacks

By John V. Schaefer

Rather than tear down a steel stack which was in a condition requiring renewal, which would force a shutdown of the pumping station at Southworks, Illinois Steel Co., South Chicago, the company decided to coat the stack with cement.

The steel stack was 175 ft. high and 9 ft. in diameter. A reinforcing network of sufficient strength to make the new stack self-supporting was built up of rods and wire mesh and secured to the existing foundation by bolts. A cement-gun was then used to shoot cement through the mesh against the steel shell of the stack to the required thickness. Fig. 1 shows the operators

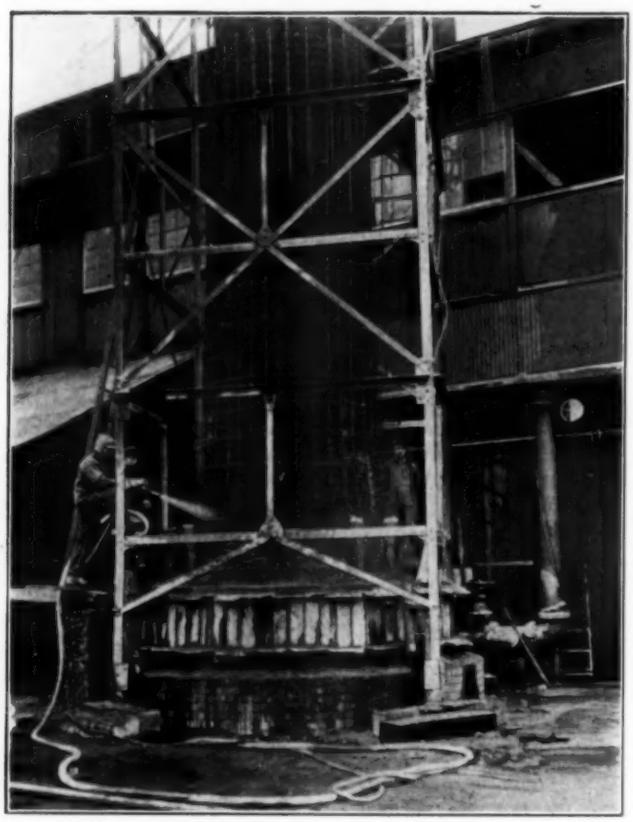


FIG. 1. BEGINNING OPERATIONS AT BASE OF STACK WITH A CEMENT-GUN

at work. A mixture of sand and cement hydrated in the nozzle was applied with an air pressure of about 35 lb. The cement is 18 in. thick at the base, tapered rapidly to 6 in. just above the bell base and then gradually decreased to 4 in. at the top. The cement-gun remained on the ground and the mixture of dry sand and cement was blown through the hose by air from a compressor working at about 50-lb. pressure. Water

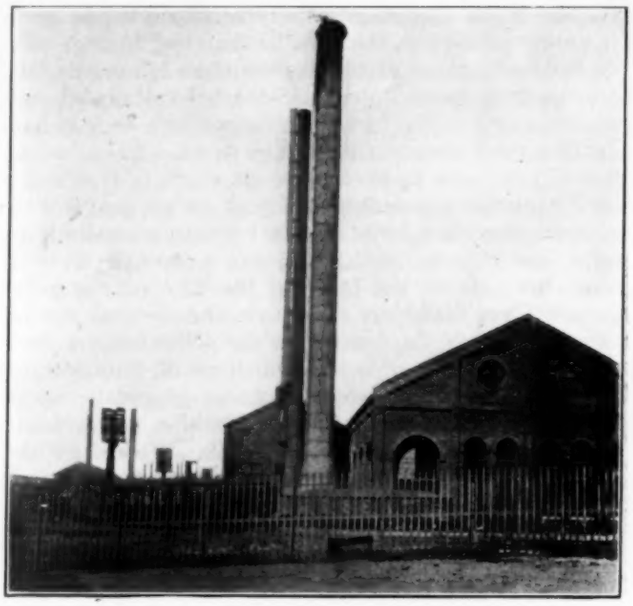


FIG. 2. CEMENT-COATED STACK

was forced through the water hose, shown in Fig. 1 as the smaller one of the two hose lines, at a pressure great enough to give a pressure at the nozzle in excess of the air pressure. The operator worked upward from the bottom, finishing as he went, so that at the end he was 175 ft. above the cement-gun, which was forcing material up to him at that point.

All the work was done without interrupting the use of the stack, the cement being applied while the stack was too hot to permit of holding the hand against it. The breeching extending from the side of the boiler house to the stack was also encased with 3 in. of cement while it was so hot that water thrown against it boiled. The completed stack, as now in use, is shown in Fig. 2.

This was done in 1918 and after nearly three years of continuous use the cement is sound everywhere and shows no cracks. Since that time a number of other stacks of various sizes have been treated in the same way, some being treated in freezing weather, others while in operation in hot weather and showing a temperature of 1,200 deg. A recent inspection shows that all of them are in daily service and perfectly sound. This not only appears to be an excellent solution of this problem, but the interesting feature of it is that the work can be done without interruption of service. This alone may sometimes be worth more than the price of the stack.

Baptists vs. Machinists

By W. L. Cheney

On the boardwalk in Atlantic City, with a "grip" in my hand, I was accosted by a long-faced individual, with the following conversational result:

"Good morning, brother, have you been to the convention?"

"As there are over fifty conventions in town, I could answer you better if I knew which convention you have in mind."

"*Why!* the *Baptist* convention!"

"No, I have not been to the Baptist convention, but to a convention of machinists."

Then, solemnly wagging his head: "Oh, well, *they* are necessary *too!*"

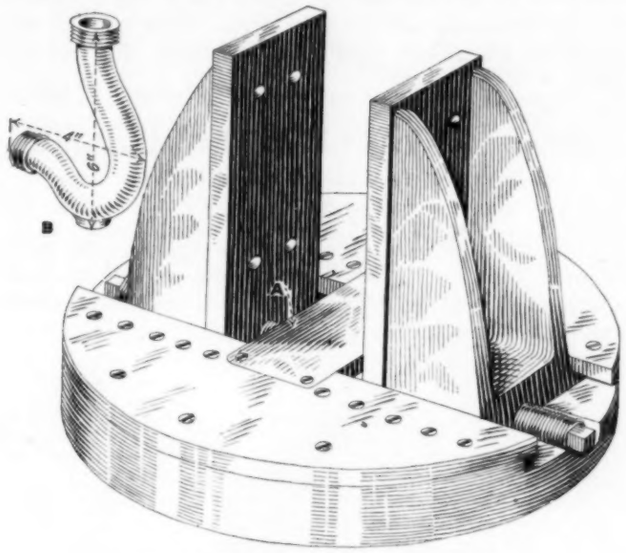
Ideas From Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered and those published are paid for.

A Chuck to Hold Unusual Jobs

BY R. GRANT

Some plumbing goods, such as traps and similar parts, present a difficult problem of machining. They are too long to be held in any ordinary chuck while the operations of turning, threading, etc., can be more



A CHUCK TO HOLD UNUSUAL PIECES

readily done in a lathe than elsewhere. Too often this class of work is done in a hit-or-miss fashion, due to lack of means to hold it properly and the resulting finished surfaces stand at all kinds of angles to each other.

It was to overcome this trouble that the special chuck shown in the cut was made and very little explanation is needed to describe it. The chuck was about 18 in. in diameter, or as large as our Warner & Swasey hand machine would swing, and had two cast-iron angle plate jaws moved by a right and left hand screw.

The jaws were about 8 in. high and 5 in. wide and an extended base reached under the steel crossbar *A* to help hold them down. A typical example of work done in this chuck would be a trap casting as shown at *B* having three operations to be done.

A pair of false jaws would be made to hold the piece and these jaws would be held on the chuck jaws by capscrews through the most convenient holes, the jaws being spotted through after lining up the work properly.

Any number of castings would be machined on one face and then the jaws shifted in turn to each of the others, but one set of jaws being needed for all operations on the same plane.

Quite a saving is made on these jaws as the ordinary chuck requires a set for each operation, and again there are no dovetails or tongues to plane and fit. The jaws may be made of iron if large quantities of the parts are to be made, while if but few parts are wanted, wood jaws can be used to advantage.

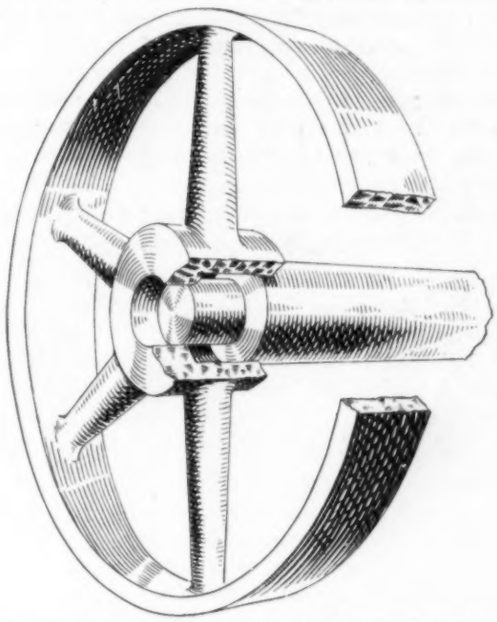
Another method of making jaws for such work is to make a plaster cast from the work, and use it as a pattern from which to cast brass jaws which are then machined to suit the chuck.

Forcing Flywheels on Shafts

BY H. S. TRECARTIN

A large manufacturing company for which I worked adopted a method of fastening flywheels to shafts that has many advantages over the customary method. Ordinarily the hub will be bored two or three thousandths of an inch smaller than the end of the shaft, and the shaft will be driven into it against a shoulder. With shafts from 2 to 8 in. in diameter and the hub 6 or 12 in. wide this forcing process is a difficult and tedious operation. By the time the end of the shaft has been driven through the 8 or 10 in. of the hub bore it is quite likely to have been squeezed to a fairly easy fit.

By boring the flywheel two diameters, as shown in the sketch, and turning the shaft to fit the two diameters, the distance that is required to drive the shaft to bring it to a fit is reduced to about a quarter of the width of the hub, and the shaft will be securely gripped at both sides of the hub. When properly keyed it will



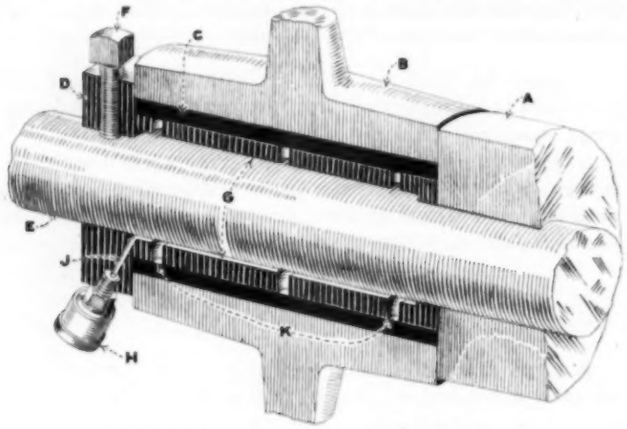
TWO-DIAMETER FIT FOR FLYWHEEL HUBS

be found that this method of construction is much more secure than the conventional one, as there will be no possibility of the shaft being tighter at the middle of the hole than at the ends.

Another Suggestion for the Cure of Loose Pulley Troubles

By Edward Heller

With reference to W. T. Elzinga's article on page 1049, Vol. 54, of *American Machinist*, relative to loose pulley troubles, I wish to relate an experience I had



A CURE FOR LOOSE PULLEY TROUBLES

with one such pulley and how the trouble was remedied. The accompanying sketch will help make things clear.

A is the tight pulley and *B* the loose one. We bored the loose pulley large enough to receive a bronze bushing *C* and a cast-iron sleeve *D*. The sleeve was held tight to shaft *E* by means of the setscrew *F*. This sleeve also had a pocket *GG*. An oil or grease cup *H* leads to it through an oil hole *J*. In addition, a number of oil holes *K* were drilled all around the sleeve, and this finished the job.

The advantage of this arrangement is that neither the shaft nor the pulley ever wears out. All the wear is taken by the cast-iron sleeve *D* and bronze bushing *C*, and even they are well provided for. The reservoir *G* contains enough oil to last for a long time and every few months, more oil or grease can be added through the cup *H*.

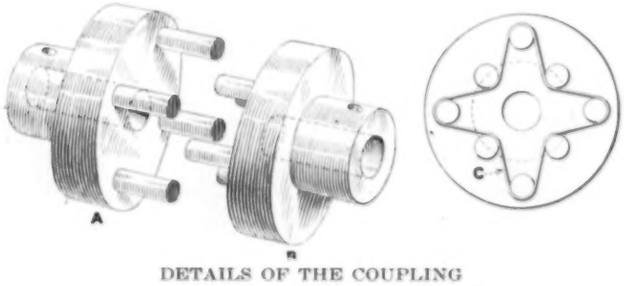
It will be noticed that the sleeve *D* acts also as a stop collar for the loose pulley and such a collar is often necessary on a job of this kind.

A Simple Compensating Coupling

By Joseph A. Olberding

Charles H. Willey's article under the above title, on page 111 of *American Machinist*, tempts me to describe a compensating or flexible coupling that we have been using for a couple of years. It is illustrated herewith.

Parts *A* and *B* are castings drilled and tapped for four ½-in. studs; *C* is a small endless leather belt about 1¼ in. wide. Part *A* is attached to the motor shaft.



DETAILS OF THE COUPLING

Part *B* is attached to the generator shaft and belt *C* is slipped on the outside of studs on *A* and inside of studs on *B*.

The result is a good self-aligning flexible coupling.

Shrinking a Bushing

By Charles Reimschissel

The hole in a bushing may be shrunk from four to six thousandths, according to its size, by the following method:

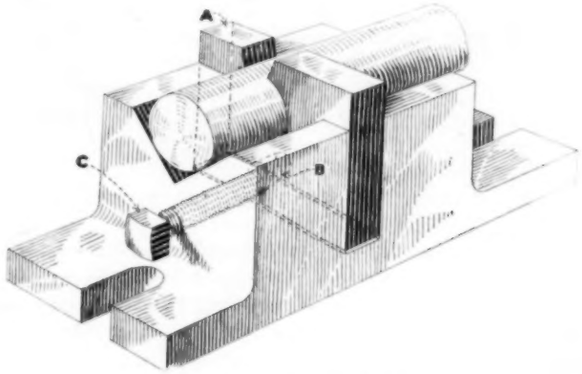
Heat the bushing to approximately 1,400 deg. F. and, holding it vertically, quench about two thirds of its length, allowing the upper third to cool in air above the surface of the water. Repeat the process, this time dipping the other end of the bushing. Reheat again and quench all over.

On short lengths the last operation is not necessary as the first two will do the work. This method will apply to all metals that will withstand the required heat.

Clamping Device to Hold Shaft for Cutting Keyway the Full Length

By Harry Moore

Certain shafts require keyways milled the entire length, and the drawing shows the special V-blocks used to hold them. The blocks are ordinary milling machine V-blocks, furnished with a tongue and made



DETAILS OF V-BLOCK

to bolt to the table. The method of holding the work however differs from the usual practice. A slot is cut through the center of the blocks to take the clamping piece *A*. This piece is bored to fit the shafts, is then cut away to clear the cutter, then a hole drilled, which is afterwards filed out as shown at *B*, the bottom portion being taper. With the V-blocks bolted in position the shaft is slipped through the clamping pieces and screw *B* tightened. This screw bearing on the tapered part of the slot in *A* pulls down the latter and seats the shaft securely in the V. Very little pressure is required to hold the work firmly.

An End Mill of Unusual Design

By Donald A. Hampson

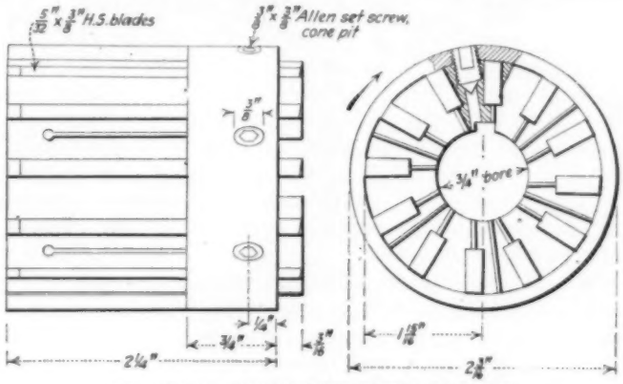
Having had trouble with the usual form of inserted blade-end mills the writer designed the cutter shown in the drawing herewith. This tool is rugged enough to stand all the belt will pull; the blades are sufficiently large to carry away the heat and maintain an edge for

one to two days' steady running on cast iron; there are no loose pieces and the wear is confined to six stock safety setscrews per cutter. The cutter circle is nearly as large as the clearance circle, and could be increased somewhat if necessary.

The drawing shows a right-hand cutter. The body is a piece of machine steel which is bored, keyseated and slotted for a dozen blades. One end of the body is turned back part way to allow a steel ring to be slipped over. This ring serves the double purpose of effectually preventing any lifting of the blades, retaining them at the point of greatest strain, and of confining the split portions of the body when the blades are tightened.

There is a saw slot at the bottom of each blade slot and six other equally spaced slots through the body, all of these ending far enough from the back of the cutter body to leave a good solid ring of metal at that end. Just as there are six slots through the body, there are six binder screws for the twelve blades. These screws are centered on the slots and are let in far enough to be flush with the outside. Their cone points bear against a similarly tapered bottom which is relieved by a small center hole, allowing the screw point to wedge itself between slanting surfaces.

In assembling the cutter, the blades are fitted to the slots and under the retaining ring. The pair of blades adjacent to a screw is effectually locked the minute the screw is tightened; the splitting of the body allows the



END MILL WITH INSERTED BLADES

sides to grip the blades close to the work. The grip thus afforded is almost unbelievable. The hollow hex head of the screw is infinitely superior to a screwdriver slot—it is positive at all times.

Because of its sterling qualities, this end mill has become a favorite with the machine operators; which is in itself an important factor in production, even if there were not the other time and money saving features to commend it.

A Back Counterbore

BY GALEN D. WATSON

The advantage of the counterbore shown herewith is that there is nothing to lose out of the bar, once the parts are assembled. The key *C* can only be removed by pushing plunger *D* down with a pointed piece of steel. The cutter *F* is notched at *A*, Fig. 3, and is a sliding fit on the bar at *B*, holding the cutter in a central position.

The bar is made of a good grade of common steel, case-hardened. The plunger, cutter and key are made of tool steel, hardened. Fig. 1 shows the tool in position to use. The taper key *C* is tapped into position lightly with a hammer, bringing pressure on the plunger *D*. The spring *E* is compressed slightly and the cutter *F* is held firmly down. Fig. 2 shows the cutter released by tapping key *C* lightly on the small end. Spring *E* pushes the plunger up into the notch in key *C* so that the cutter can be removed. The whole operation can be

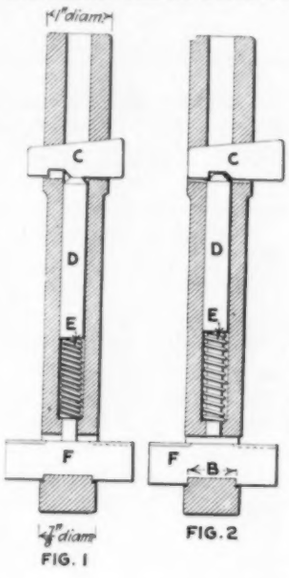


FIG. 1

FIG. 2

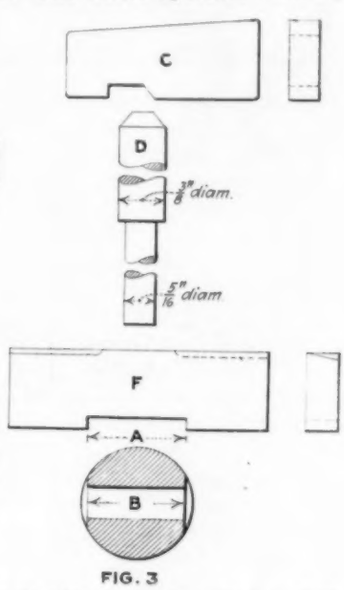


FIG. 3

FIG. 1. THE COUNTERBORE READY FOR USE. FIG. 2. THE COUNTERBORE WITH CUTTER RELEASED. FIG. 3. DETAILS OF COUNTERBORE PARTS

done quickly and easily. Details of the parts are shown in Fig. 3.

This tool has been in use three months in the plant of the Hyde Windlass Co., Bath, Me.

A Taper-Turning Attachment for a P. & J. Automatic

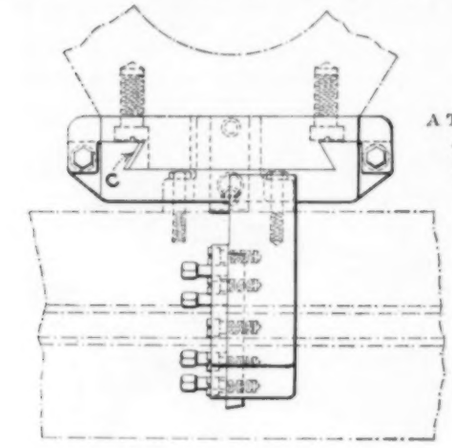
BY J. W. KAISER

The accompanying sketch shows the details of an automatic taper-turning tool which was constructed in our shop some time ago for use on a Potter & Johnston lathe. We had a number of short tubes 3 in. O.D. which were to be bored 2 in. deep and to have a 10-deg. taper turned on the outside. As the equipment included a number of P. & J.'s, it was decided to rig up the lathes with the fixture shown. The result was practically a perfect job with a minimum of upkeep. These fixtures were in use for nearly five years and all the repairing required was the grinding of the taper block *F* about every six months.

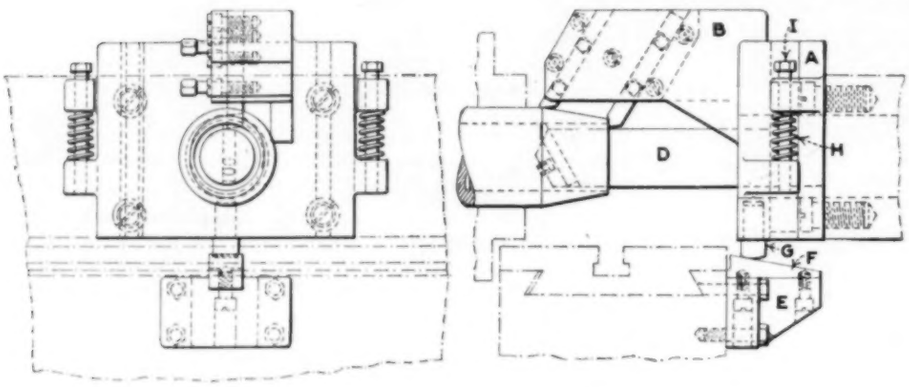
Part *A* is bolted solidly to the face of the turret. Part *B* slides on part *A*, the gib *C* being used to obtain the proper sliding adjustment. In the overhanging arm on part *B* are inserted the boring and facing tools, which are held in the usual way with a plate and setscrews. An oblong hole is cored through *B* for clearance for the boring bar *D*, allowing it to slide vertically as required. The boring bar is held by a shank which is a snug fit in the turret and in part *A*. The bracket *E* is bolted to the cross-slide and carries the hardened taper block *F* which is tapered to correspond with the angle required on the work. *G* is a hardened pin in the bottom of part *B*. As the turret advances this pin rides on the taper block *F*, raising the entire block which holds the tools and thus turning the taper.

The pressure necessary to hold the tool to the work while cutting and also to bring *B* back to the original position for starting is supplied by the stiff springs *H*

which are inserted between the lugs cast on *A* and *B*. The distance that part *B* can drop is limited by the screws *I* which pass through a clearance hole in the part *A* and are screwed into the lugs in part *B*. While this



A TAPER-TURNING ATTACHMENT FOR A P. & J. AUTOMATIC



action is taking place, the boring tool in bar *D* is boring a straight line in the work as shown.

The same idea was followed in rigging a tool for boring taper holes, with the exception that a boring bar holder was used in place of the overhanging arm. The results were equally as good.

Refinishing Anvils on Measuring Instruments

By W. C. Betz

The contact faces on measuring machines and the anvil and spindle end of micrometers need refinishing after a period of service.

The tools necessary are a small India oilstone, medium grade, ¼ x 1 x 4 in., and four cast-iron laps varying in thickness by 0.006 in., these latter pieces to be numbered from 1 to 4. The oilstone should be cleaned thoroughly with gasoline and lapped parallel on a piece of planed cast iron, using No. 1-F carborundum as an abrasive. The abrasive is sprinkled on the lap and the stone rolled over the grains. As soon as the charging material becomes dull or sticky it should be removed and new abrasive sprinkled on.

The set of cast-iron laps are ground parallel and charged with No. 3-F carborundum on one side only, using a hardened and ground block for the purpose.

It seldom happens that a micrometer or other measuring instrument is used until it is in such bad shape as to need regrinding, but if it should happen through neglect or injury, this should be done before attempting to lap.

The end of a micrometer spindle may be ground in a bench lathe by inserting the spindle of the micrometer through the rear end of the spring collet and grinding it with the regular attachment furnished with the lathe. The anvil can best be ground in place in the micrometer frame in a tool, or cylindrical, grinding machine by gripping a small piece of steel in the headstock chuck and grinding it so that the micrometer spindle bore wrings on it.

A saucer wheel is substituted for the regular grinding wheel and care should be exercised to insure that the cross-slide travels at exactly 90 deg. with the headstock spindle. The plug with the frame wrung upon it is turned so as to present the open side of the micrometer frame to the wheel and the headstock locked in position. The anvil is then ground by passing the wheel by the anvil face as in grinding a snap gage.

To finish the contact faces by lapping, the oilstone is laid on the charged side of one of the cast-iron lap pieces and the combination is inserted between the measuring faces of the tool and the lap is drawn in all directions to bring the whole stone surface into contact with the work. Care should be taken that the tension on the lap is just enough to hold the faces in contact, otherwise the tool will be sprung.

After one surface is roughed the lap is reversed and the other face is similarly treated, leaving the surfaces in a semi-finished condition. The oilstone is now removed and the cast-iron lap is used to finish the surface, reversing this so that the charged side comes into contact with each face in turn.

One of the laps is sufficient for lapping the faces of non rotating spindle instruments, including vernier calipers, but for micrometers and tools where one of the faces rotates it will be necessary to use the four laps alternately, both on the oilstone roughing and the finish lapping operation, for the following reason: To lap a rotating spindle instrument the oilstone is used with lap No. 1, and the anvil end cleaned of all wheel or wear marks. Piece No. 2 is next used, also on the anvil, and this lap is 0.006 in. thicker than No. 1. It follows that the spindle end of the instrument is in a position approximately 90 deg. from the first one and would quickly show whether or not the spindle end was parallel to the anvil by a few passes of the second lap.

By using all four laps it can be seen that different positions are presented with each lap, changing 90 deg. each time; which would show the difference beyond mistake by the cross lap marks on the anvil. The relation of the spindle face to the center line could be quickly determined, and by reversing the laps and using them on the spindle end this surface would soon be finished exactly square with the center line.

It might be necessary to use the laps alternately on the anvil and spindle end a number of times to bring the faces parallel, with the spindle in any position.

The idea of using the four laps is analogous to the three-plate method of finishing plane surfaces; if the anvil and spindle ends are parallel, the lap marks on these surfaces will show evenly by a few passes of all four pieces.

EDITORIALS

The Three T's of Prosperity

ACCORDING to a recent statement by John G. Shedd, president of Marshall, Field & Co., prosperity hinges on Congressional action on taxation, the tariff and transportation. Of these three T's it is hard to pick the one most deserving of immediate and wise action.

The revenue bill will be before the Senate for final action before this gets into print and we may therefore expect action that fulfills at least one of the requirements just mentioned. As to the other there is considerable doubt unless the bill is changed in some particulars. In the meantime little is being done to reduce government expenditures.

The tariff act is certainly in no danger of receiving hasty attention from the Senate and may perhaps be benefited by the delay which is bound to occur before its final passage. As it left the House it contains much that can stand revision. As we see it, any tariff provision that will be a hindrance to foreign trade is likely to have the same effect on domestic trade in the long run, although indirectly, of course.

When it comes to transportation it is obvious that with our present national economic organization we cannot get along without adequate railroad transportation and at reasonable rates. The service is adequate for the present small volume of business but there is a dangerously large percentage of bad order freight cars and the figures for deferred maintenance loom large. As to rates, while their altitude may be necessary to the life of the railroads, few men can be found who will call them reasonable. If business increases, rates can be reduced, say the railroad men; if rates are reduced, business will increase, say the business men and farmers. Truly, the problem before our legislators is not easy, but it must be attacked and at once.

A Three-Plane Navy

THE program of tests and attacks soon to be made on the U. S. S. Alabama has just reached us. It indicates encouraging enterprise on the part of military and naval men in an endeavor to supplement the recent bombing tests which were hardly conclusive.

The present tests may be no more conclusive than the others but the program leads us to believe that at least some additional information will be obtained as a result. There are to be two day attacks and two night attacks, and an attempt is to be made to determine the effect of the new chemical weapons upon naval craft. Tear gas, phosphorus bombs, smoke screens for aircraft, parachute flares and demolition bombs are among the various implements to be tried out on the condemned ship which seems likely to come to a very useful end.

If the first line battleship is unable to resist night attack from the air with chemical or explosive weapons it is high time more attention was paid to the aviation branch of both services and less to the terribly expensive big gun ship. A forty-million-dollar dreadnought is a very imposing evidence of the defensive power of a nation but much of its impressiveness vanishes when it is unable to defend itself from a forty-thousand dollar airplane carrying modern fighting equipment.

The tests will be watched with interest by the manufacturers of the country for they should go far to indicate whether our principal reliance in the next war, if disarmament measures prove ineffective, is to be on the machine shop or the chemical plant. There are those who feel that the day of mechanical warfare is passing, to be succeeded by chemical warfare too deadly to be contemplated without horror. If this opinion is justified it will be well to have the facts in the hands of those who are building and authorizing our first line of defense, as the navy has come to be looked upon.

We have made no mention of the submarine for the reason that its success in the last war is indisputable. It is unlikely that we shall ever know just how close the German U-boats came to changing the final decision for that is something which those in a position to know do not care to talk about.

We are very hopeful that President Harding's disarmament conference will be productive of results which will reduce the likelihood of future wars, but in the meantime it will be well to keep on with our experiments to determine how best to defend ourselves from military aggression.

What Can the Unemployment Conference Accomplish?

THE much talked of unemployment conference is now sitting in Washington. There has been a deal of speculation as to just what such a gathering can accomplish, for men interested in the general subject of reduction of unemployment have not forgotten what happened to the two attempts made by the Wilson administration to solve the same problem. It is to be hoped that the same fate does not overtake this one.

The list of names of those accepting Mr. Harding's invitation includes some of the ablest men on industrial relations in this country. With Mr. Hoover in the chair, the stage is set for a supreme effort to remedy the situation. If failure is the result it should prove conclusively that it is useless to try to hasten the working out of economic processes.

No More Extra Fares?

AN ANNOUNCEMENT comes from the Chicago passenger agent of the Pennsylvania Railroad that hereafter no extra fares will be charged on the crack trains of his road running between Washington and Chicago. Here is good news for the Western Congressmen who must needs get back home frequently to mend their fences.

It seems almost too good to be true that anything can be done to reduce the cost of fast traveling. We have looked forward so long to a time when it would be possible to make a business trip without bankrupting the cashier that we can hardly believe that at last the first move has been made. But here we have it in black and white. There is evidently still something to live for.

Shop Equipment News

Henry & Wright Dieing Machine

The art of working sheet metal by means of fixed tools attached to suitable mechanisms and performing the operations of piercing, blanking, forming, stamping, etc., either separately, progressively, or simultaneously, is as old as the machine industry itself. The tools for producing the multiplicity of parts that are made from this material are almost as many and as varied as are the articles produced. Notwithstanding the complexity of modern press tools, there has been little change in the design and appearance of the machine that operates them. Ever increasing in size and power to keep up with the demand for larger pieces of heavier material, or as more and more operations were combined in one set of tools to speed the output, the punch press of today still looks very much like the punch press of a hundred years ago.

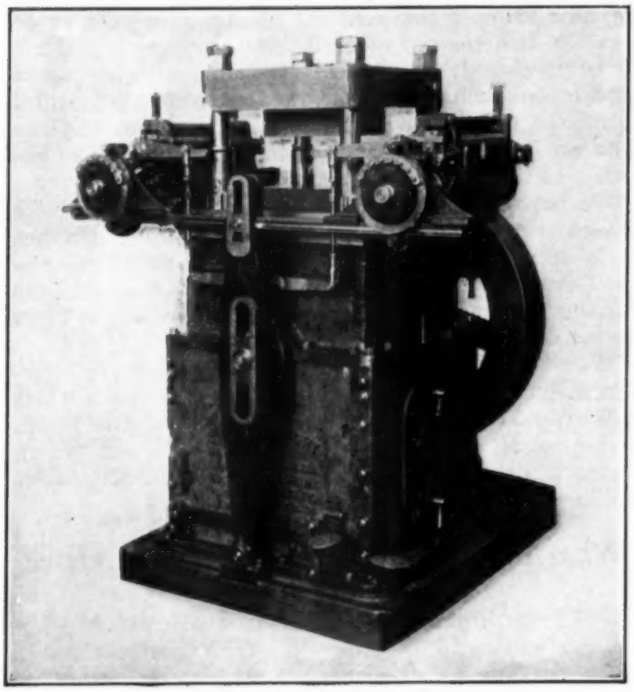


FIG. 1. FRONT VIEW OF MACHINE

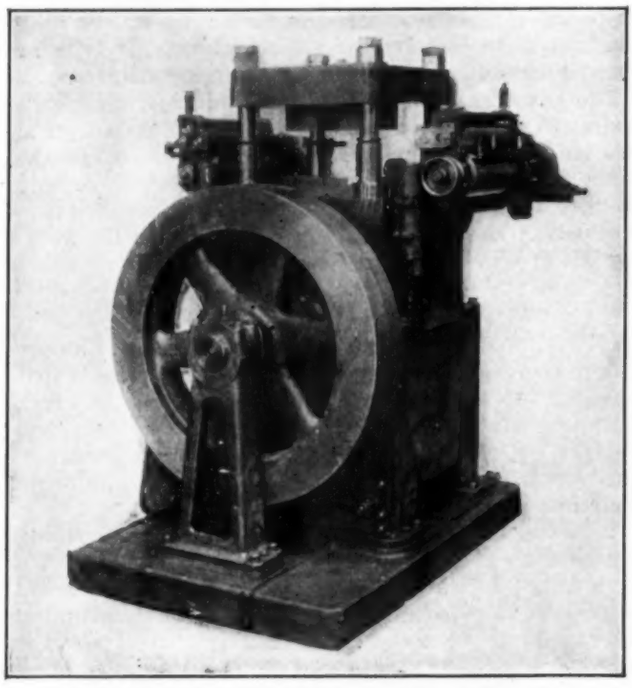


FIG. 2. REAR VIEW, SHOWING FLYWHEEL

It remained for the late Daniel M. Wright, of the Henry & Wright Manufacturing Co., Hartford, Conn., to effect the permanent combination of punch press and pillar-press in the machine described on pages 498 and 499, vol. 49, of *American Machinist* some three years ago, and now known to the trade as the Wright "dieing machine." In this machine, which is a radical departure from the usual punch-press construction, Mr. Wright inverted the mechanism, placed the heavy flywheel on the back side near the floor where it can be suitably guarded, and enclosed all the moving parts except the tools themselves within a cabinet base where they are protected equally against dirt and unwary fingers, and where ample provision is easily made to resist and absorb side stresses. Front and rear views of the complete machine equipped with double roll feeding devices, are shown in Figs. 1 and 2. The cabinet base is made in two built-up sections the lower one of which is fitted with a removable panel that, when opened, renders the working parts of the machine easily accessible for inspection or adjustment. The crankshaft passes transversely through the base at the point of junction of the upper and lower sections and has its bearing in the under side of the upper section so that by unbolting this section the crankshaft with all attached working parts may be lifted out as shown in Fig. 3. By locating the crankshaft at this point, the thrust is upward against the upper base section and the stress imposed by the cutting of metal is thus entirely one of the compression,

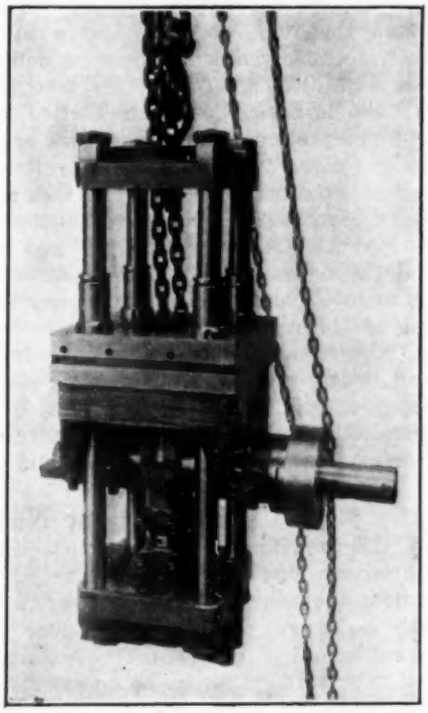


FIG. 3. THE WORKING PARTS LIFTED OUT OF THE BASE

borne by this single casting, the upper surface of which is the die-bed.

In Fig. 4 is a side view of the machine with the panel removed. From the crankpin the connection rod or pitman extends downward to where at the lower end it is joined by a wristpin to a slide or "gate" *A* of the same general shape and dimensions as the upper head that carries the punches or moving member of the tools. This gate moves up and down on two large square-section guides bolted to the inner sides of the base and these guides resist the angular thrust of the pitman.

The upper head is rigidly connected to the gate by four chrome-nickel steel rods, shouldered into the castings at either end and firmly held by double nuts, so that gate and head move together as one unit. The rods pass through long bushings of bronze that are fitted to tapered seats in the upper base section; the bushings are split and provided with adjusting nuts by means of which any wear upon the rods or bushings may be compensated for. The rods are under tensile stress only; any sidewise pressure being borne by the bushings in the same plane as the tools and consequently no bending strains are imposed. The ample guiding surfaces of the lower gate likewise relieve the lower ends of the rods from all side pressur

The weight of the combined reciprocating unit, as well as of the upper tools when the latter are in place, is more than counterbalanced by heavy coil springs, one of which may be seen at *B*, located under the lower gate, so that in making adjustments for position in setting tools there is no possibility for them to drop upon the dies; the pressure is always in the other direction. Height adjustment, to determine the amount the punches shall enter the dies, is made by means of the usual right-and-left screw and locknuts in the pitman.

The crankshaft extends through the front of the base and terminates in a disk with adjustable crankpin and block, the latter engaging in the slot of a vertical lever that is fulcrumed at the base of the machine and attached at the upper end by a yoke to a sliding rack that transmits movement to both sets of feed pawls. The movement of the rack, and consequently the length of the feed, can be minutely adjusted by the operator without moving from his position in front of the machine.

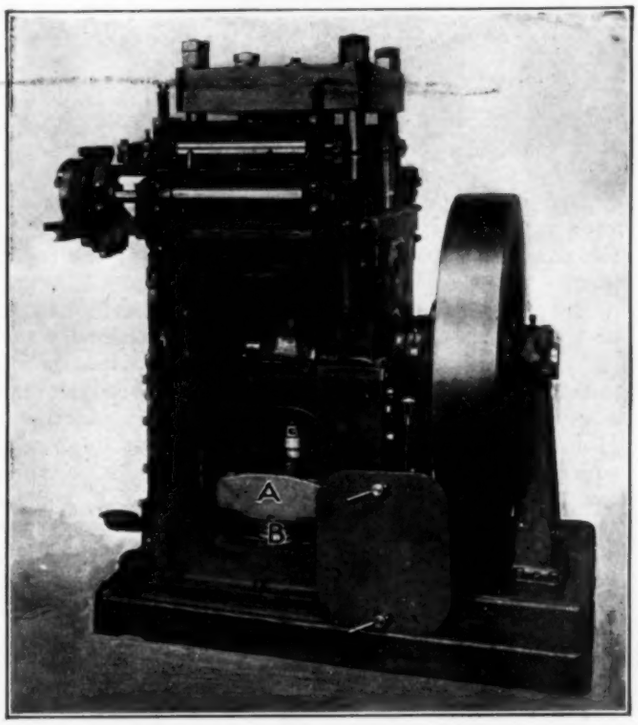


FIG. 4. SIDE VIEW WITH PANEL REMOVED

Both sections of the feeding mechanism are mounted upon pillars at the rear of the die bed and can be instantly unlocked and swung out of the way as shown in Fig. 5 when it is necessary for the operator to get at the dies. The absence of overhead parts and the accessibility of the dies from all sides makes the tool setter's job a comparatively easy one.

The clutch is in the flywheel and may be operated by either of two treadles, one of which locks in the clutch for continuous operation while the other gives a single stroke for each depression. When one treadle is depressed it automatically locks the other out of action so that a double stroke of the machine while setting the dies is impossible.

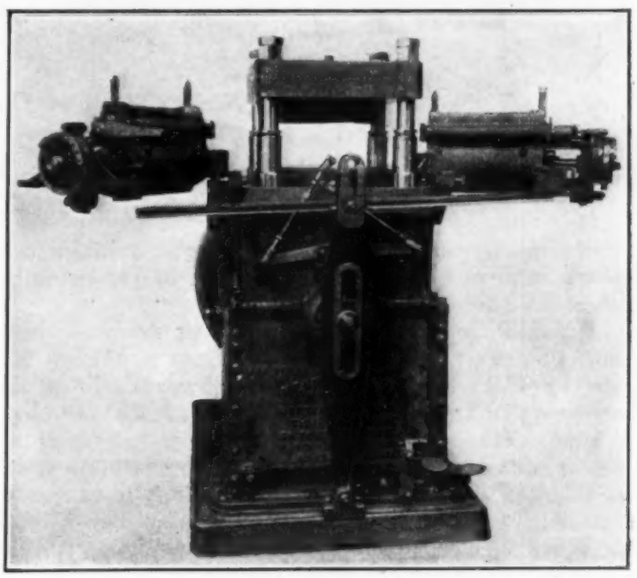


FIG. 5. SHOWING ROLL FEEDS SWUNG BACK FOR SETTING TOOLS

The machine is made in three sizes, designated respectively as 10-, 25-, and 50-ton capacity. The larger machine stands 64 in. high and occupies a floor space of approximately 5 ft. square. It weighs 5,400 pounds. The standard length of stroke is 1½ in. but this can be supplied to suit the customer.

Lees-Bradner Gear Grinding Machine

A machine for grinding the teeth of gears is shown in Fig. 1, it being designated as the No. 10 gear-tooth grinding machine, and recently placed on the market by the Lees-Bradner Co., Cleveland, Ohio. The machine is intended for grinding the faces of involute spur-gear teeth, being capable of working on gears having pressure angles of from 14½ to 24 deg., diametral pitches from 12 to 3, and pitch diameter from 2 to 12 inches.

The abrasive wheel used is 30 in. in diameter and of the saucer type, the grinding face being ground plane. The wheel is supported on a stationary column, and the work is traversed past it on a slide having a reciprocating action. Besides the linear motion, the work is given the correct rotary motion, so as to obtain the desired profile on the tooth face. In this way, the tooth

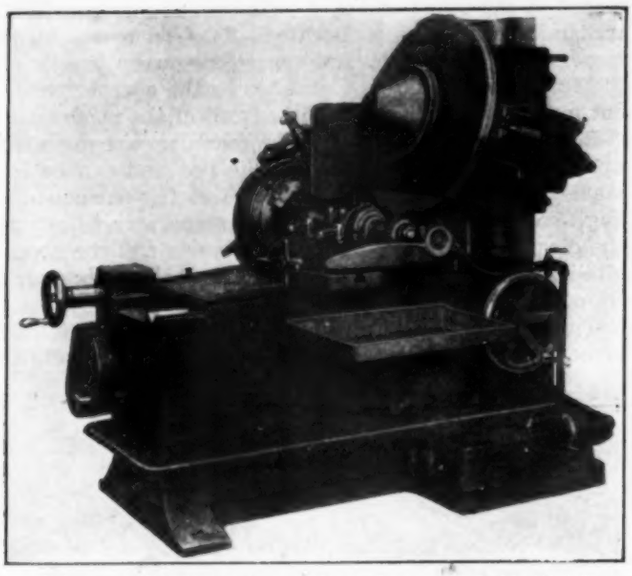


FIG. 1. LEES-BRADNER GEAR GRINDING MACHINE

is generated, as the action is that of a gear rolling along a rack, the rack tooth being the face of the grinding wheel.

The machine may be driven by belt from an overhead line shaft, or driven directly from a motor. The wheel spindle is driven from the countershaft of the machine by a belt contained inside of the base and column. The wheel can be set at the proper angle by means of a worm and segment on the swiveling head. It is trued by means of a diamond, that is caused to travel in a straight line by the use of either a lever or a screw mechanism used in conjunction with the micrometer feed on the wheel spindle.

The work can be held between centers, or supported on a mandrel having a taper shank to fit the spindle, and carried at the outer end by the tailstock. The indexing is accomplished by means of hardened and ground plates secured to the work spindle and inclosed within a case. It is automatic, occurring at each end of the travel of the slide, so that the wheel passes through a different tooth space at each successive stroke. It is said that the tool is capable of generating a perfect involute and of leaving a smooth finish on the face of the tooth, because of the fact that continuity of action is obtained between the wheel and the profile of the gear tooth. It is said that it is not necessary to center the blank.

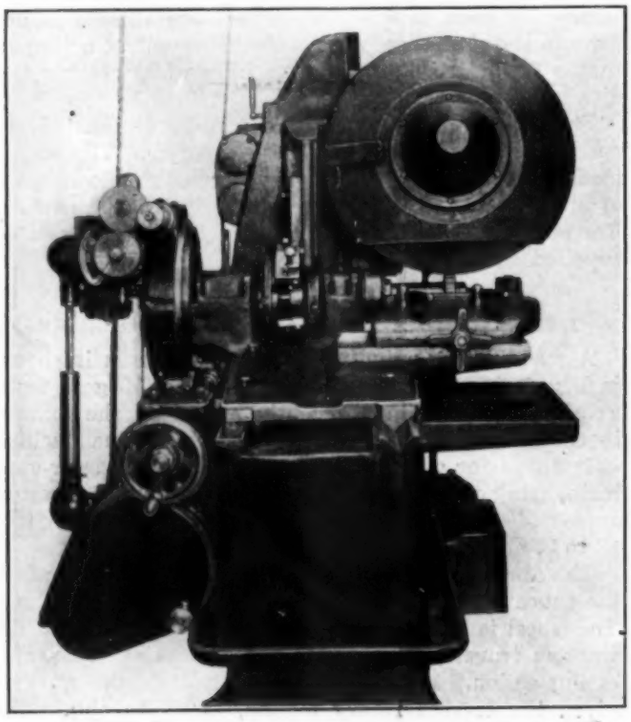


FIG. 2. END VIEW OF LEES-BRADNER GEAR GRINDING MACHINE

The fact that the work is rotated when the slide moves, by means of tapes secured at one end to the bracket on the column and rolling on the other end over a disk with the exact size of the pitch circle of the work, is said to give a more uniform conversion of linear motion into rotary motion than can be obtained by means of racks and gears. The power for moving the slide is not applied directly to it, but is applied to the sleeve that rotates the work spindle. As the sleeve is rotated, first in one direction and then in the other, the tapes are wound and unwound on the segments on which they run. In Fig. 2 can be seen the mechanism operating and controlling the rotation of the work spindle.

The gearing in the feed box is driven from the main pulley shaft, and change gears are used to vary the number of strokes per minute of the work slide. The length of travel of the slide is regulated by a dog located inside of the gear case.

To operate the machine, a segment equal to the pitch diameter of the gears to be ground is first located on the work spindle. The abrasive wheel is then set at the pressure angle of the tooth to be ground, and the head carrying the wheel is located for the correct working depth of the tool. The wheel is then dressed. The ordinary method of procedure is to remove a roughing cut, usually 0.003 in. in depth, and then to feed the micrometer 0.001 in. to finish the teeth. This latter adjustment of 0.001 in. thus brings the wheel back into the generating plane, and the one in which it was dressed.

When the wheel requires dressing, which is usually for every other gear, only 0.0004 in. is taken off the face. In order to make this feed, the micrometer adjustment is moved so that the starting and finishing stops do not have to be disturbed. A notched disk and lever pawl, allowing the wheel to be fed up 0.0002 in. for each notch, permits of compensating for the reduction in the size of the wheel.

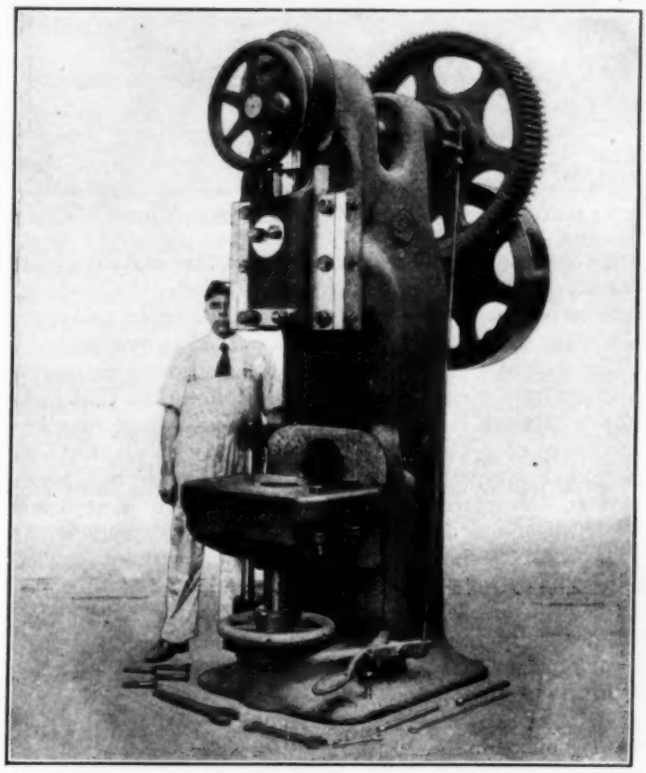
The roughing of the gear teeth can ordinarily be done best by means of hobbing, and it is not necessary that the work be done accurately, so that speed can be obtained. It is stated that in an actual test on grinding, a 6-pitch gear having 31 teeth was done in a total of 11 min., with a loading and unloading time of 2 min., so as to average 30 gears per 9-hour day. A roughing and a finishing cut were taken on each gear, and the complete grind around required 5 min. On this class of work, the grinding wheel is said to have a very long life, so that about 2,500 gears of the size just mentioned can be ground with one wheel.

Ferracute Adjustable-Bed Punch Press

The Ferracute Machine Co., Bridgeton, N. J., has recently built the press shown in the illustration for work requiring a long stroke and unusual height

between the bed and ram. The machine is known as an adjustable-bed punch press. The bed has a vertical adjustment, by means of which the distance between the bed and the ram may be varied, instead of the bed and the frame being in one casting, as in the ordinary form of press. The connection between the bed and frame, which must, of course, be rigid, is made by heavy bolts and the 4-in. adjusting screw, which seats in the base. A projection at the back of the bed fits a vertically planed recessed guide in the frame, in order to keep the bed parallel with the bottom of the ram.

The press may be used for horning by inserting a horn in the 9½-in. hole in the frame at the back of the bed. The hinge formed by the stud at the side of the press enables the bed to be swung out of the way when the machine is used as a horning press. The ram has 3 in. adjustment, and the bed 9 in. A distance of 30 in. is given between the bed in its lowest position and the ram at the top of its stroke and at its highest adjustment. The stroke of the ram is 8 in. The press exerts a pressure of 70 tons and weighs 13,200 pounds.

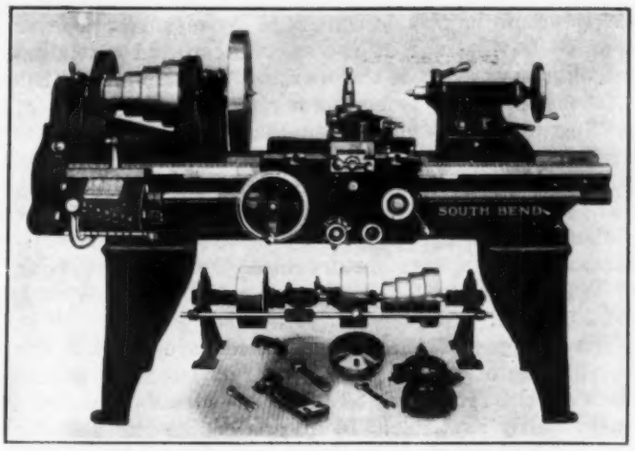


FERRACUTE ADJUSTABLE-BED PUNCH PRESS

South Bend Quick Change Gear Lathe

The South Bend Lathe Works, 425 East Madison St., South Bend, Ind., has recently placed on the market the quick-change lathe shown in the accompanying illustration. The machine is similar in general construction to the plain type of change gear lathe made previously by this concern. The feed box that has been added is of the type used on the Flather lathe, the maker having secured the right to build the device of this type. Forty-eight changes of feeds and threads are provided, these changes applying also to the crossfeed. The gears are made of steel forgings and are changed by means of the two levers shown at the box, a pin in the end of the tumbler lever holding it in position.

The lathe is made in sizes of 9, 11, 13, 15, 16, 18, 21 and 24 in., with either straight or gap bed. The bed is heavily cross-ribbed, and has three V's and one flat way for guiding the headstock, tailstock and carriage. The headstock has phosphor-bronze bearings and an improved type of reverse mechanism. The carriage is provided with T-slots for clamping work to it, as when milling and boring. All of the feeds are controlled from the front of the apron, and are so interlocked that only one feed can be engaged at a time.



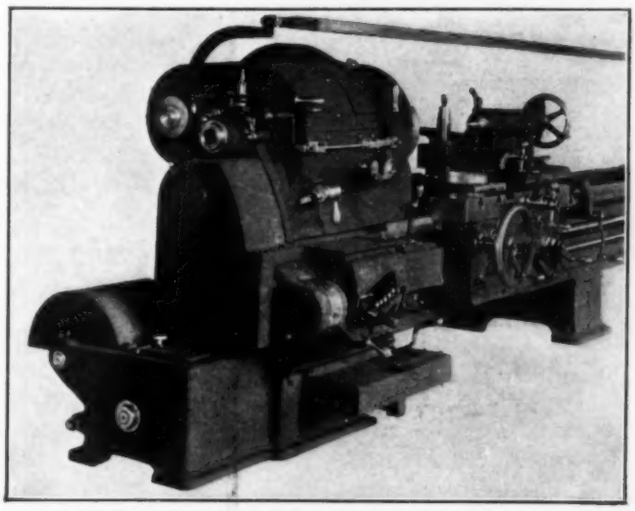
SOUTH BEND QUICK CHANGE GEAR LATHE

The lathe is equipped with large and small faceplates, graduated compound rest, follower rest, adjustable stop for screw-cutting, semi-machined chuck-back, gear-guards, wrenches and double-friction countershaft. If desired, milling and key-way cutting attachment, motor drive, taper attachment and other extras can be furnished.

Bradford Quick-Change Geared-Head Lathe

The Bradford Machine Tool Co., 8th and Evans St., Cincinnati, Ohio, has recently placed on the market the style of double back-geared, all-geared-head engine lathe shown in the accompanying illustration. The machine is very similar in general characteristics to that described on page 91, Vol. 51, of the *American Machinist*, the principal difference being in the use of the double back-gears.

The lathe illustrated is of 30-in. size, although it is made in swings of 26, 28 and 32 in. It is intended for either single-pulley or direct motor drive. The double



BRADFORD 30-IN. DOUBLE BACK-GEARED LATHE

back-gear mechanism is controlled by means of a lever mounted on the rear of the spindle cap and extending to within easy reach of the operator. In this mechanism is incorporated a locking arrangement that permits of shifting the gears only when they are free from the driving action; that is, when the clutch on the main spindle is in the disengaged position. Both of the back gears cannot be engaged at the same time, so that abuse of them is thus prevented. By means of the arrangement, eighteen speeds are provided, these varying from 6.7 to 282.5 r.p.m. The back-gear ratios are 12.57 to 1, and 3.55 to 1.

The changes of threads and feeds are obtained by the shifting of gears. By the use of 16- and 64-tooth gears on the feed stud, 32 standard threads and feeds are instantly available. By means of the two shifting levers, 16 changes of feed are provided without the changing of any removable gears. For threads of coarse and odd pitch, the lead screw is geared directly to the spindle, in which case the quick-change gear box is not used.

Jackson Vertical Milling Machines

The Jackson Machine Tool Co., Jackson, Mich., has recently placed on the market the vertical milling machine shown in Fig. 1. The machine is made in two sizes, and its principal features are the same as those of the No. 5 and No. 6 die-sinking machines made by the same concern. However, it is made for such work as that on drop-forging dies, where a cherrying operation is not required, and where a vertical-spindle milling cutter can be employed.

The head that carries the vertical milling spindle is bolted to the column. The spindle has a vertical movement manipulated by hand through a mechanism which permits of both hand feed and rapid traverse. Near the lower end of the spindle is a vertically sliding bracket, which carries both the main spindle bearing and the thrust bearing. It is operated for slow feed by the handwheel, and for rapid traverse by the spoked wheel near it. A slight turn of a small knurled handwheel engages or disengages the slow feed, the rapid traverse being free to operate when the slow feed is disengaged.

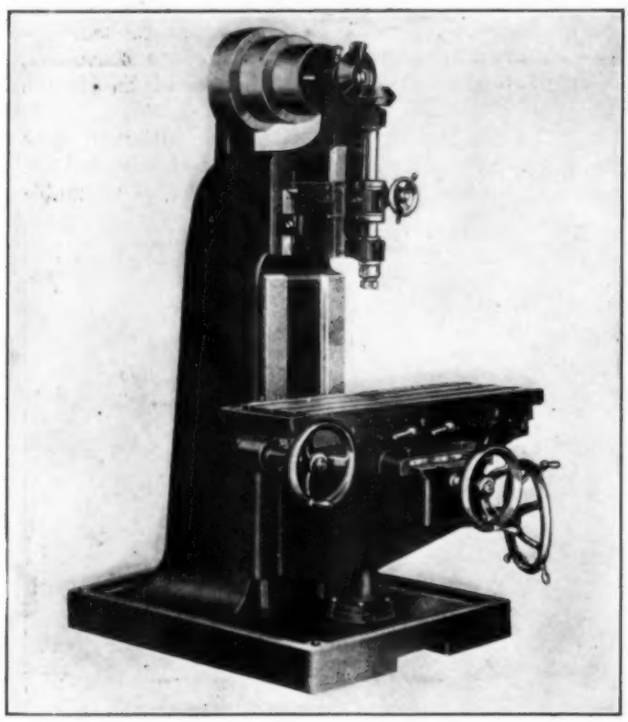


FIG. 1. JACKSON VERTICAL MILLING MACHINE NO. 5-A.

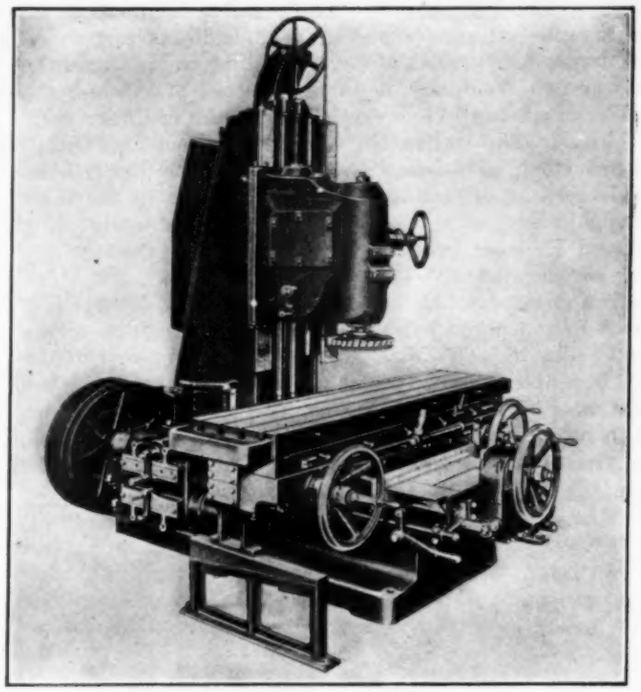


FIG. 2. JACKSON VERTICAL MILLING MACHINE NO. 10-A.

The weight of the spindle and housing is counterbalanced by a weight inside of the column, so that lost motion between the cutting tool and handwheel may be taken care of. The spindle housing may be clamped in position for cutting after the proper depth has been obtained. A micrometer stop is provided for determining depth of cut and vertical position of the spindle.

The machine is made either with or without power feed. The spindle has speeds of 200, 325 and 520 r.p.m., and is provided with a No. 11 B. & S. taper hole. The distance from the center of the spindle to the face of the column is 14 in., and the cross travel of the table 13 in. The table is 13 x 40 in. on the No. 5-A machine, and 13 x 48 in. on the No. 6-A machine, the longitudinal travels being 32 and 40 in., respectively.

The vertical milling machine shown in Fig. 2 is intended for production work on die-sinking, being practically the same as the No. 10 die-sinking machine described in the *American Machinist* on page 1122, Vol. 48. The difference is that the head carrying the vertical spindle and cherrying mechanism has been changed to one carrying a heavy vertical milling spindle. The No. 10-A machine has a table and cross-rail feed ranging from 0.001 to 0.015 in. per revolution of the spindle, while the No. 10-B machine has a range of feeds from $\frac{1}{8}$ to 6 in. per minute, regardless of the speed of the spindle.

Inside of the head is a back-gear arrangement providing thirteen changes of spindle speed ranging from $8\frac{1}{2}$ to 310 r.p.m. A pull-pin lever on the left-hand side of the head provides the means for changing from the direct drive to the back gear, the other changes of speed being secured in the speed-change gear box on the left-hand side of the base near the drive pulley. The lower end of the spindle has a flange $6\frac{1}{2}$ in. in diameter, and is provided with a $\frac{3}{4}$-in keyway and a No. 13 B. & S. taper hole.

The standard sizes of cutters are 4, 6, 8, 10, 12 and 14 in. in diameter. A circular table 36 in. in diameter may be provided for circular and continuous milling. The feed changes are controlled at the feed-change box on the right side of the base near the back of the machine.

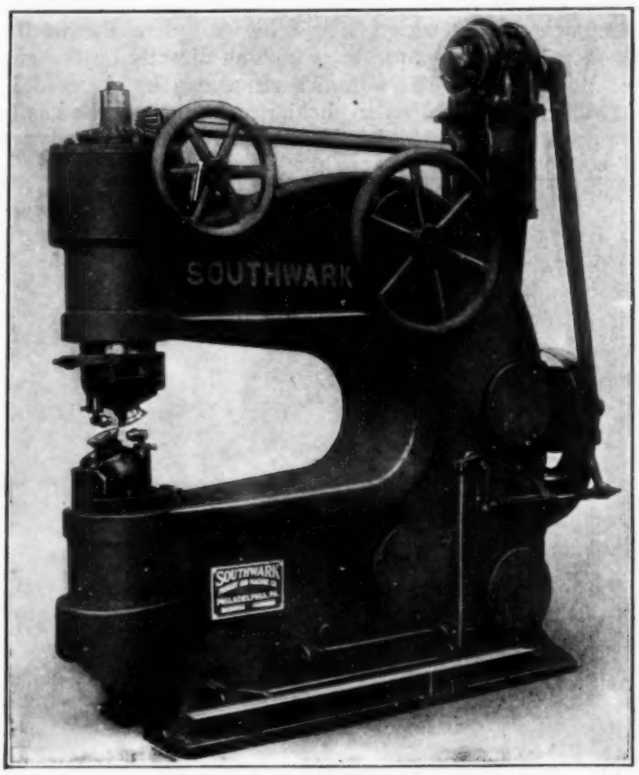
The distance from the center of the spindle to the face of the column is 18½ in., while the maximum distance from the table to the end of the spindle is 27 in. The head has a vertical movement of 24 in. The table, which is 18 x 72 in. on the working surface, has a longitudinal travel of 56 in. and a cross travel of 18 in. The driving pulley runs at 300 r.p.m., a 10 to 15 hp. motor being required.

Southwark-Gray Turret Rotary Shears

The No. 1 Gray turret rotary shear, made by the Southwark Foundry and Machine Co., Philadelphia, Pa., was described on page 1115, Vol. 52, of the *American Machinist*. That machine was intended for cutting metal up to 14-gage.

Since that time, several new models of the machine have been placed on the market. The No. 0 machine is intended for cutting steel of 16-gage or less, and can be mounted either on a bench or a pedestal and controlled by a foot lever. It has a cutting speed of 8 ft. per minute. The diameter of the cutters is 1½ in. and the throat depth is 18 in. The driving pulley runs at a speed of 200 r.p.m., and ¼ hp. is required. The machine is 2 ft. 2 in. in height, 3 ft. 6 in. in length and 1 ft. 6 in. wide.

The No. 2 machine is intended for handling metal up to 8-gage. It employs a cutting speed of 10 ft. per minute, with cutters 2½ in. in diameter and requires 1½ hp. to operate, the speed of the driving pulley being 265 r.p.m. It is made with a throat depth of 30 in., a floor space of 5 ft. 9 in. x 2 ft. 3 in.; height of 6 ft. 9 in



SOUTHWARK-GRAY NO. 3 DOUBLE-TURRET ROTARY SHEAR

The accompanying illustration shows the No. 3 machine, which has very recently been placed on the market. This model differs from the others primarily in the fact that it employs two turrets, the lower cutter being mounted at an angle in a turret resembling the upper one. The machine is intended for cutting metal up to ⅜ in. in thickness, employing a cutting speed of 10 ft. per minute. The diameter of the cutters is 4 in. and the throat depth 36 in. The driving pulley runs at a speed of 285 r.p.m., and 3 hp. is required to operate the machine. The total height is 6 ft. 6 in., and the floor space 7 ft. 3 in. x 3 feet.

The machine is driven by a motor mounted on top of the frame, a pedal being placed at each side of the machine for controlling the operation of the driving clutch. The machine can be handled from either side, as the controls are duplicated. The metal can be fed into the turret shears from any direction, the control of this feature being given by revolving the turret. The two turrets keep the same relative position at any degree of the circle to which they are revolved, the handwheel at the top of the machine being used to rotate them. Because of the fact that the cutters, while working, can be changed to any degree of the circle, the machine can be employed to cut various shapes without turning the sheet or plate in the machine. The machine is said to produce a smooth, clean and square edge.

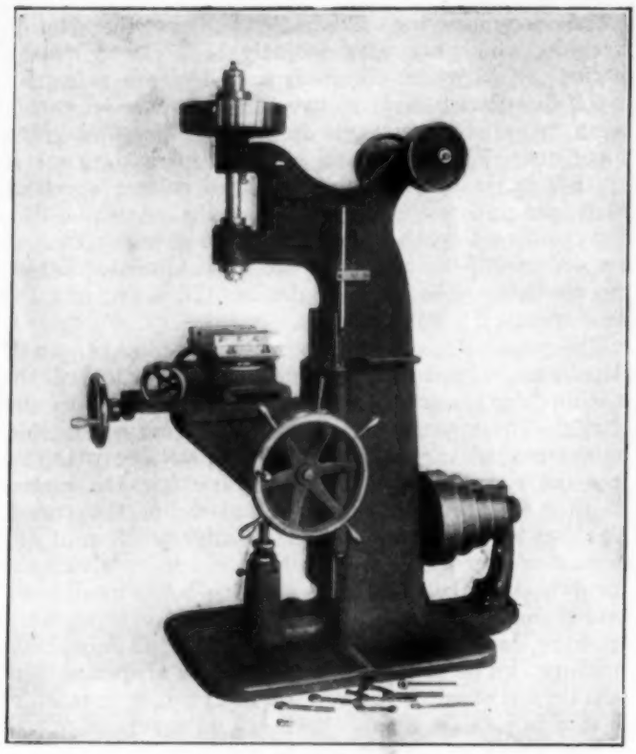
Any shape or opening can be cut, with the minimum radius at the corners equal to the radius of the cutters. Cuts as wide as the throat depth can be made in one continuous operation, but greater widths up to twice the throat depth are cut by first shearing in as far as possible from one edge and then turning the plate so as to work from the opposite edge. When following a line laid out on the plate in making a cut, the course of the cutters is changed by turning the handwheel mounted on the head, while the plate itself maintains the original position. The rotation of the cutters automatically feeds the stock through the shear. If desired, the plate can be guided by hand.

On all of the machines except the No. 0 both of the cutters are rotated by power. Changing the speed of the cutters is controlled entirely by means of the treadle engaging and disengaging the clutch. Only one operating speed is required, as it is claimed that the machine can be started and stopped so easily that it is not necessary to have more. When starting a cut on the inside of a sheet, the cutters are forced through the plate before they are rotated. The adjustments on the shear are so made that the cutters will not interfere when moving them toward each other.

It is claimed that the floor space is less than is generally required for machines of this type, because of the fact that it is not necessary to swing a large sheet while working upon it. The machines are adapted for work of all grades, from aprons, shields and pans for automobiles to large locomotive, bridge and structural work. The small sizes of machines can be operated by one man, while the largest size can ordinarily be handled by two.

Improvements in Pratt & Whitney Die-Sinking Machines

Several changes in design have been made in the die-sinking machines built by the Pratt & Whitney Co., Hartford, Conn., to make them more convenient to operate and easier to maintain.



PRATT & WHITNEY DIE-SINKING MACHINE

In the machine illustrated herewith the driving spindle has been provided with a positive pin lock for four positions, so that the chuck or collet can be tightened without holding the driving belt. The spindle pulley has a system of oil grooving opposite to the direction of rotation, so that oil is continually carried upward, insuring complete lubrication without loss of oil. A floating babbitt washer takes the thrust of the cut on the spindle, a system of oil grooving distributing the lubricant evenly over the entire bearing surface.

The main drive cone has been fitted with a hollow spindle having communicating oil holes delivering the oil to a series of felt-packed grooves, conserving the lubricant and insuring an ample supply. To protect the ways from chips and dirt, leather wipers, held by cast-iron caps, are attached to the knee, fitting close to keep all foreign matter out of the mechanism.

The vise capacity has been increased, and the vise has been strengthened in proportion to this greater capacity. A telescopic elevating screw is now furnished in place of tne single-piece screw previously employed, thus obviating the necessity for boring a hole in the floor. The elevating wheel shaft is provided with a thrust bearing for ease of operation.

The outboard bearings for the knee and vise slides have been strengthened to reduce the chance of breakage, and the slides themselves are grooved and protected.

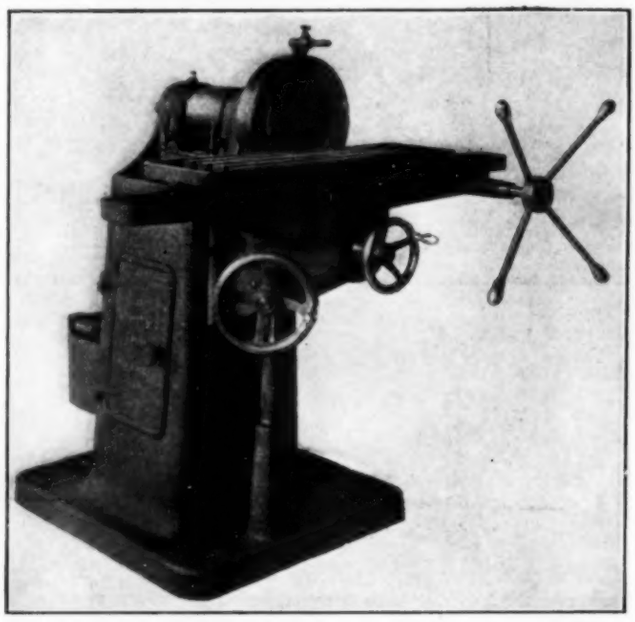
Graham Knee-Type Ring-Wheel Grinding Machine

The Graham Manufacturing Co., 71 Willard Ave., Providence, R. I., is placing on the market the knee-type, ring-wheel grinding machine shown in the accompanying illustration. The machine is known as the No. 41, and, although it greatly resembles a knee-type milling machine in general construction, it might well be called a horizontal-spindle face-grinding machine.

The column of the machine is of heavy box section, and has a high bead at the edge of the base in order to catch waste fluid. Wooden shelves are ordinarily provided on the inside, being placed on cast ledges, or the interior space may be used for the starting box. The head of the machine is a sepaarte part, being secured on the top of the column. The spindle is mounted in Timken roller bearings, which are carried in large removable bushings. The front bushing is tight, and so placed as to reduce the over-hang. In order to take care of end-play, the rear bushing has a close sliding fit and is held in position by a strong helical spring, so that it automatically takes up end motion and wear. Larger adjustments are made by means of a castellated nut. Felt-packed dust collars protect all running parts, and glass oilers indicate the height of the lubricant around the bearings.

The machine is shown equipped for belt drive from an overhead counter-shaft or motor. It can also be very well driven from a motor mounted on a bracket at the back of the machine and attached directly to the spindle through a flexible coupling. The maker favors this arrangement, because the motor and its support thus balance the knee and table at the other side of the column. The motor can be belted to the machine, being placed on a bracket behind the column and near the floor, a method often desired in order to obtain the necessary speed for the spindle. The motor can also be placed inside the column and belted upward to the spindle. A compact unit is provided when the motor is built into the head and mounted directly on the spindle, but this arrangement has disadvantages, partly because end-play is not allowable in the spindle.

The abrasive-ring holder is made of pressed steel, and the abrasive ring itself is clamped in place by drawing a split cone-shaped ring around it into a taper in the body. By means of an adjustment flange screwed upon a large hub in the ring, the abrasive ring may be set out as wear occurs. The heavy hub or center of the holder is fastened to a collar shrunk directly on the end of the spindle. The abrasive rings can be changed in the holders, or the entire holder and ring can be easily removed and replaced. The abrasive rings used are



GRAHAM KNEE-TYPE RING-WHEEL GRINDING MACHINE

12 in. in outside diameter and either 7 or 8 in. on the inside diameter. They are 3 in. in thickness when new, and can be worn down to ½ in. or less, it is said.

The knee is of box section, and is elevated by means of a handwheel set at an angle. The table block on top of the knee has gibs fitted for movements in two directions. It can be moved transversely by means of the handwheel at the front of the machine, the shaft being provided with a dial, so that the depth of cut can be easily adjusted and read.

The table, which slides longitudinally on the table block, has a working surface of 10 x 24 in., and is provided with a trough to catch the cutting lubricant. It can be reciprocated by means of the pilot wheel.

The water supply is furnished by a No. 2 B. & S. centrifugal pump, being secured to the tank, settling pan and strainers at the rear of the machine. The pump can be driven from the spindle or the countershaft. The water is applied to the work through a nozzle fastened to universal pipe joints. In the photograph the guards for protecting the operator from splashing have been removed.

The machine is said to have a capacity for grinding surfaces 6 x 12 in. in size. The extreme travel of the table is 16 in., and its transverse movement is 3½ in., while the table can be raised to the center of the wheel and lowered 7 in. Ordinarily the head is set over just enough to give clearance, so that only one side of the wheel touches the work, the effect not being appreciable enough to cause the surface to be concave. However, the head can be set perfectly straight, the capacity of the machine being greatly increased. The sparks then fly downward at one side and up at the opposite side of the wheel.

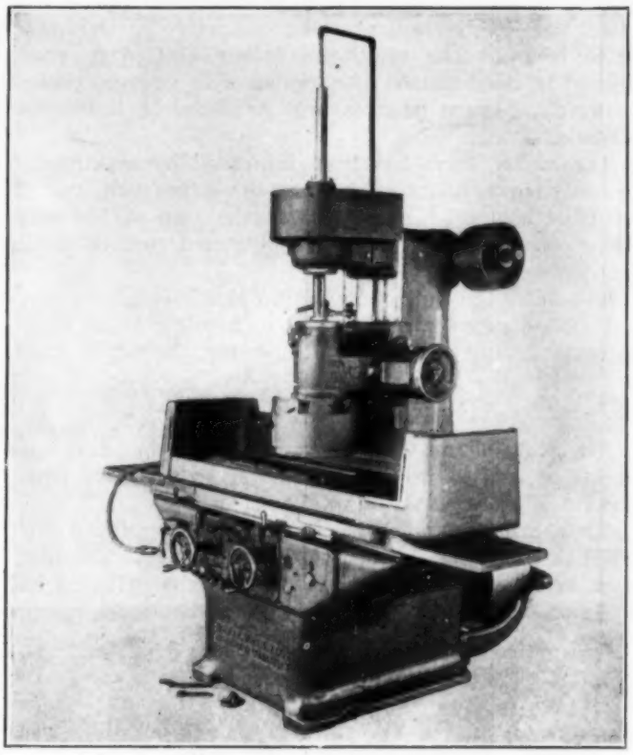
The maker calls particular attention to the method used for dressing the abrasive rings in order to control the speed of cutting. It is possible to dress the face of the wheel so that only a narrow band cuts, the rest of the wheel being relieved. The speed is, of course, much greater when the band is on the outside of the ring than when it is at the inside edge.

A holder for the diamond used in dressing the ring is furnished for mounting on the table. Special equipment and modifications can be provided for, so that the machine can be applied to special work. Automatic feeds can be supplied. It is possible to mount two heads side-by-side, one for roughing and one for finishing at one pass of the work.

It is stated that the wheel is ordinarily driven at a speed of 1,780 r.p.m., the horsepower required varying from 5 for light work to 15 for heavy jobs. The spindle of the machine is 42 in. above the floor, and the floor space required is about 6 sq.ft. The machine weighs about 2,000 pounds.

Improvements in Pratt & Whitney 14-In. Vertical Surface Grinding Machine

A number of changes have been made and improvements incorporated in the design of the vertical surface grinding machine built by the Pratt & Whitney Co., of Hartford, Conn. The ball bearing mounting of the spindle has been redesigned, the weight of the wheel unit now being carried on springs set against the upper bearing. This provides an automatic take-up so that no adjustment for wear is necessary. All openings are carefully guarded from grit and moisture by the interlocking construction of the parts.



IMPROVED P. & W. 14-IN. VERTICAL SURFACE GRINDING MACHINE

Lubrication in the upper section is provided for by oil dripping through the bearing from regulation oilers and falling into whirling cups, which throw it back into the bearing by centrifugal force. In the lower section the oil is poured into a large reservoir, from whence it flows through the upper bearing and runs along the spindle to the lower bearing where the grinding wheel faceplate acts as a retainer. Ribs on this plate throw the oil up into the bearing by centrifugal force.

An aperture in the column, fitted with a removable cover, provides easy access to the spindle counterweight. The table drive has been strengthened by the introduction of hardened shafts, gears and clutches, lubricated from sight feed oilers on the front of the case. Split bearings are now used, and the feed shaft has been fitted with a keyed coupling so that the entire drive shaft unit may easily be removed. Hand operation of the table has been simplified by providing a sliding gear in place of a clutch on the handwheel shaft. The table reverse is assured of smoother action by means of a dwell in the pinion drive so that the table comes to a stop before reversal takes place.

The idlers over which the main drive belt runs have been equipped with roller bearings, lubricated by extra large grease cups in the ends of the stationary shaft. Frictional power losses are minimized and smooth running is assured. The spindle drive pulley is surrounded by a heavy sheet-metal guard.

The tank has been redesigned. A series of baffle plates, cast integral with the tank proper, are provided with openings alternately at the top and bottom so that the solution flows over and under these plates in such a manner that in the last compartment where the solution is drawn off by the pump it is clean and free from grit. Cleaning the tank is a simple matter, as the settling pan can be lifted off, giving accessibility to all compartments.

To add to the oil-retaining capacity of the main drive cone at the rear, the hollow stationary shaft (keyed to the bracket) is supplied with grooves packed with felt. These grooves are connected to the center oil hole.

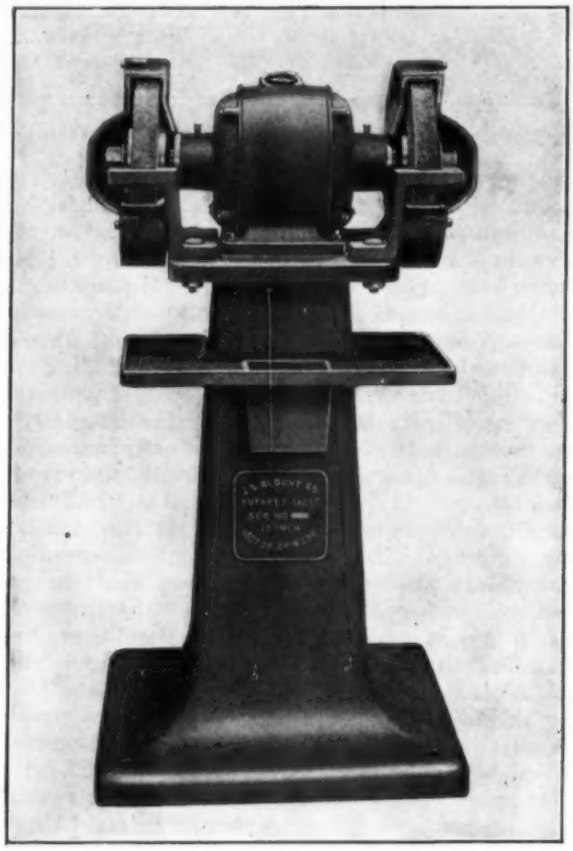
The motor drive has been improved by making the motor base adjustable, so that the drive belt can be adjusted correctly in relation to the step of the main drive cone. This prevents creeping and curling of the belt.

The drive for the rotary tilting chuck (plain or magnetic) is equipped with a flexible coupling which facilitates mounting the unit and aligning the drive shaft.

Blount Motor Grinder

The J. G. Blount Co., of Everett, Mass., has developed a line of alternating current motor grinders of which the cut illustrates the 2-hp. 12-in. size.

They are of rugged design and are equipped with SKF ball bearings in dust-proof mountings. The bearings are secured to the shaft by a light drive fit and locknuts. The spindles are of high-carbon steel, ground



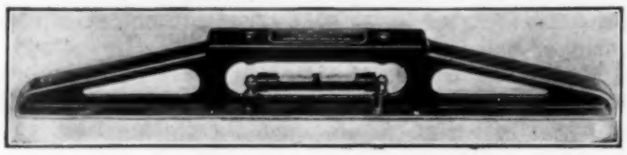
BLOUNT MOTOR GRINDERS

to size. The rests are of one piece and adjustable. Flanges are machined all over and inner flanges are pressed to shoulder of spindle. The tool tray and water pot, which are bolted to the column, are separated and detachable. The equipment includes two grinding wheels, one coarse and one fine, unless otherwise specified. Motors are of the Westinghouse design and the starting switch is of textile snap type.

The machines are built in the following sizes: ½ hp., 8 x 1-in. wheels; 1 hp., 10 x 1½-in. wheels; and the 2 hp., 12 x 1½-in. wheels.

"Universal" Precision Machine Aligning Level

The illustration shows a precision level just placed on the market by the Universal Boring Machine Co., Hudson, Mass. The development of this level is due to the experiences of the field men of the company in



"UNIVERSAL" ALIGNING LEVEL

finding imperfect leveling at the bottom of many of the machine troubles they were called to correct. While this level is a general purpose instrument it is particularly adapted to the leveling of machine tools.

The metal frame is 27 in. long, truss construction and the base has an accurately scraped bearing. While the casting is well seasoned it may be rescraped if at any time it should become necessary. The handle is molded of a non-conducting material to keep the warmth of the hand away from the main frame as much as possible. Its design also protects the vial, particularly from the careless or ignorant user.

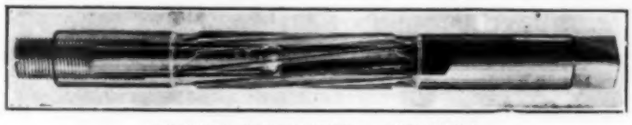
The vial is made of the best Jena glass, specially ground and is filled and graduated by an expert level maker. It is guaranteed to be accurate to 5 sec. of arc per graduation, that is, 0.0002908 in. per ft., and is mounted so that it can be adjusted both in vertical and horizontal planes.

The frame is finished in dull black, the vial case in black japan and the brass adjusting studs and screws in lacquer. A handsome well-finished, felt-lined mahogany case protects the instrument when not in use. The case is also equipped with a strong metal handle.

Kruce Spiral Expansion Reamer

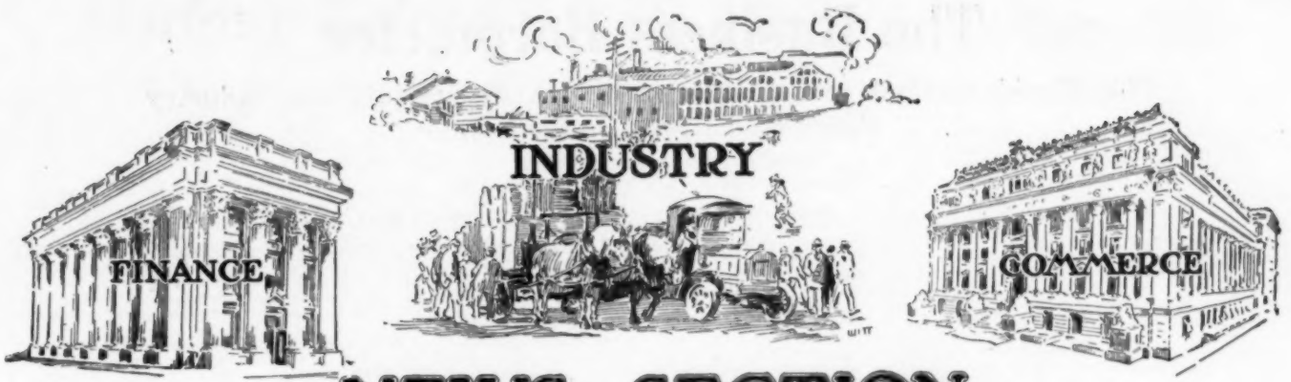
The expansion reamer shown in the accompanying illustration has recently been placed on the market by E. J. Kruce & Co., 322 Harper Ave., Detroit, Mich. The tool is especially intended for reaming piston-pin holes, but can be adapted to other uses. It is said that the adjusting device offers a large range for expansion and gives ease in operation; also that the expansion is concentric, and is not affected by an accumulation of dirt in the slot. When released from its expansion limit, the reamer returns to its original size. Because of the fact that the blades are helical, key-seated or oil grooved parts can be reamed without chatter.

On the reamer shown, the front end of the body is ground 0.005 in. undersize to fit unreamed pin-holes, while the rear end is ground 0.001 in. undersize for a



KRUCE EXPANSION REAMER

free fit of the hole after reaming. The adjusting screw at the front end is turned by means of a screwdriver, so as to drive forward the expanding roll, which revolves freely on the end of the screw. The roll centralizes itself in the tapered hole in the body and expands the reamer evenly to the oversize required.



NEWS SECTION

Industrial Relations Association To Meet in New York

The annual convention of the Industrial relations Association of America will be held at the Waldorf-Astoria, New York City, Nov. 1, 2, 3 and 4. The fourth and last day session will be a joint one with the Academy of Political Science of New York at the Astor Hotel.

The dates of the convention were first fixed as Nov. 8, 9, 10 and 11 but the calling of the Disarmament Conference in Washington for the week of Nov. 7 made it advisable to change the dates to the preceding week in order that certain of the Cabinet officers might be present.

It is proposed to present a program covering the things most vital at the present time to the successful administration of industrial relations and its kindred work. Practical men will talk on the practical side of industrial relations.

British Steel Men Return to England

Four British steel men sailed for home last week after a short visit in this country, during which they appeared before the Senate Finance Committee and gave testimony to prove that the proposed tariff rates on high-speed steel would have the effect of putting several Sheffield steel manufacturers out of business. The delegation consisted of J. C. Ward, president Edgar Allen Steel Co., Ltd., Sir Sidney Robinson of Wm. Jessop & Sons, Peter MacGregor of Sanderson Bros. and Arthur Balfour of Arthur Balfour & Co., Ltd., who acted as spokesman in presenting their views in Washington. In conversation with an *American Machinist* representative, Mr. Ward said that the delegation was very much pleased with the reception that had been given them at the capitol and felt that they had impressed the members of the Finance Committee of the Senate with the justice of their claims. A portion of Mr. Balfour's testimony appears on another page.

British Iron Trade Resuming

Birmingham reports a better tone in the iron trade, due mainly to more favorable reports from Sheffield and South Wales. It is believed that some improvement will soon be felt, and furnaces in the Midlands are being prepared for relighting as soon as conditions warrant a resumption of work. In the Middlesborough district, it is stated, only five blast furnaces have as yet been restarted, but two more may be in operation shortly. The high price of coal and coke is delaying a revival, and until there has been substantial fall no general return to work can take place.

On the Clyde no blast furnaces are at work, though after the holidays the iron and steel works are expected to be in full operation to clear off accumulated arrears of work. New orders are, however, far from plentiful. In anticipation of better times some of the vessels laid up in the Clyde are being made ready for sea.

There is little prospect of much activity in the iron and steel industries of South Wales for some months, but the tin-plate and galvanized sheet works are fairly busy. The latter are using considerable quantities of Belgian steel.

Howard Campbell Goes to Chicago as Western Editor

Howard Campbell, who joined the staff of the *American Machinist* last winter, has been appointed Western Editor with headquarters at the Chicago office of the McGraw-Hill Co. Inc., 1570 Old Colony Building. The western territory is not new to Mr. Campbell as he came to the *American Machinist* from the *Michigan Manufacturer*, of Detroit, where he was a special feature writer. He has worked in several middle western shops from apprentice to superintendent and is well fitted to carry the editorial service of the *American Machinist* to the shops in his territory. Mr. Campbell will be in Chicago on October first.

Douglas Sees Prosperity, Based on Demand for Farm Products

The measure of the country's volume of business and of its commercial welfare in the future is to be found in the demand for farm products and their consequent prices, says Archer Wall Douglas, chairman of the Committee on Statistics of the Chamber of Commerce of the United States, in his monthly review of crop and business conditions in *The Nation's Business*.

"The story," says Mr. Douglas, "is much the same everywhere: A partial and unequal harvest; plentiful returns in close juxtaposition with parched and burnt up field; prices and demand for farm products that are far from satisfactory to the producers. Yet these same products are seeking a market wherever they can find it that the obligations of the farmers may be discharged. There is an abundance of foodstuffs in the country despite small yields in some grains.

"Sustained higher prices for cotton mean an amount of business in the South that can come from no other cause. Nor does it seem to be likely that there will be that fatal and futile holding of cotton for possibly higher prices that characterized the previous season. The memory of that desperate mistake and its enduring consequences are too recent to be repeated.

"If there is a demand of any moment, foreign and domestic, from now on—and this at least seems likely—the greater portion of the carry-over of cotton in this country will have been practically used up by July of next year. With general business and readjustment on an ascending scale, at home and abroad, we shall be facing a situation where the greater part of the world's supply of cotton will depend on the growing crop in this country. What such a contingency means to the prosperity of the South sounds too optimistic to put in cold print.

"The new phase of the situation already finds expression not only in widespread more cheerful feeling in the South; but also in somewhat freer buying. This is true likewise in the grain regions where farmers are liberally marketing hogs, wheat and corn.

"The commercial world, however, will not reap as much benefit from this as surface indications seem to promise. A very considerable proportion of the money the farmers receive for their products will go to settling the obligations carried over. In some sections when banks and dealers have been satisfied there will not be much left for the farmers for new purchases. Yet when all has been said the situation will be far better than at present."

Admiral Griffin, U. S. N., Retires With Honors

Robert Stanislaus Griffin, for more than eight years head of the Bureau of Engineering of the Navy Department and engineer in chief of the United States Navy, terminated his long period of active service on Sept. 22 when he retired to private life. The use of electric propulsion on battleships was put into effect many years earlier than would have been the case had Admiral Griffin been a less determined champion of that type of drive. There was strong opposition to what was termed experimentation with a vital feature of a fighting ship. Admiral Griffin, however, did not recommend the electric drive until he had made the most careful study of its application on the collier "Jupiter." Now that the superiority of electric propulsion is conceded, Admiral Griffin retires with the full satisfaction that his judgment has been vindicated.

In reviewing the accomplishments of the Bureau of Engineering under his administration, Admiral Griffin subordinates everything else to the accomplishments of his organization during the war. The engineering features of the maintenance of an enormous fleet were carried out with a success which has called forth the highest praise from the British and the French.

The development of which Admiral Griffin is perhaps more proud than any other is the work done by his Bureau on the radio. Under his direction, high powered stations have been built on the Isthmus, at San Diego, at Pearl Harbor, at Cavite and at Annapolis. The greatest achievement of all, however, was the erection of the world's most powerful station at Bordeaux. This great project was carried to satisfactory completion, despite the feverish haste which characterized every step of the work. The decision to erect the Bordeaux station was reached when there was grave fear that the Germans would be able to hunt out and cut the transatlantic cables. To have had communication severed in those critical days would have been disastrous. Had the Germans succeeded, the station at Bordeaux would have made it possible to maintain communication under all circumstances.

Throughout his more than forty years in the naval service, Admiral Griffin has been an active contender for an increased proportion of engineering talent in the Navy personnel.

Admiral Griffin was born in Fredericksburg, Va., Sept. 27, 1857. He was graduated from the Naval Academy in 1878. He holds the degree of Doctor of Engineering from Stevens Institute of Technology, and Doctor of Science from Columbia University. For his services during the war, he was awarded a distinguished service medal, was made a commander of the Legion of Honor of France and was elected an honorary member of the American Society of Mechanical Engineers.

Exhibition at Mining Congress

Plans are being quickly formulated for the exhibition of mining machinery and products which is to be held in connection with the American Mining Congress at Chicago, on Oct. 17 to 22.

Nearly every mining state in the union will be represented, as well as Mexico and Alaska. The Bureau of Mines will have an exhibit of the shale industry.

The Business Barometer

This Week's Outlook in Commerce, Finance, Agriculture and Industry Based on Current Developments

BY THEODORE H. PRICE
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Were it not that the recovery in business that I have so long and so confidently predicted is still in its incipiency I should be suspicious of its permanency because its arrival is now generally recognized and acclaimed. "The West Cheerfully Faces the Winter," "Trade Revives in the Lower South," "The Steel Trade Makes Further Gains," "The Iron Trade Turns the Corner," "Business Gains Headway," "Even Pessimists Are Becoming Hopeful," "Survey Shows Business Is Improving," "Buoyancy in Many Trades," "Dry Goods Sales Big," "Trade Is Picking Up," "Trade Improvement Noted in the South," "Trade Revives," "Business Speeding Up, Says Chicago," "Industrial Gains Real, Says Bank," "Prosperity at Hand, Says Secretary Davis," are some of the headings that appear over the stories of better business that the newspapers published last week.

The detail of the week's record seems to justify the almost unanimous optimism that now seems to be felt. Except in the cotton market, which continues to hang around twenty cents, there has been no speculative outburst to make the situation dangerous and in neither stocks nor commodities is the buying as yet beyond the legitimate investment or consumptive demand.

The weekly statement of the Federal Reserve Bank shows a further increase of $26,000,000 in the gold on hand as a result of which the reserve ratio is up to 68.7 per cent. The New York bank in particular has added $106,000,000 to its gold holdings and its reserve ratio has risen from 75.7 to 84.1 per cent during the week.

It is not surprising, therefore, that the New York and Boston banks have reduced their rediscount rates to 5 per cent or that there is a general expectation that the other ten banks will soon follow suit. The growing ease of money has made the best commercial paper easily salable at 5¼ per cent and good bankers acceptances have found buyers at 4¾ per cent. Reflecting this decline in the rental value of credit, investment bonds are active and higher under the leadership of "Libertys" which have been bought with confidence. The stock market has been quiescent but the better class of railway and industrial securities have been in fairly good demand at slightly higher prices.

The Government has thus far succeeded in selling about $63,000,000 of the railway equipment trust notes that it held upon a 6 per cent basis. These are being resold to the public to yield 5.75 to 5.85 per cent and if enough can be marketed it may be that the War Finance Corporation will find itself able to give the railways the assistance needed without the legislation so eagerly hoped for a month ago.

The United States Steel Corporation has advanced its principal products $5 a ton or more and the independents are expected to follow suit. The cotton goods market is steady but those merchants who are frank admit that the advance has to some extent checked buying. Silver, long regarded as a barometer of the world's trade by English merchants, is up to 41¾ pence per ounce in the London market. This is the top of the present movement and compares with a low of 30⅜d. touched last March. An increasing demand for diamonds, which is nearly always accepted as an indicator of prosperity, is reported by the dealers in jewels. An advance of 20 yen per picul in silk in Japan is another straw which indicates a quickening in the demand for luxuries. A similar inference is to be drawn from the success of a large fur auction held in New York last week.

At a convention of the tea and coffee trade held in Indianapolis figures were presented showing that the consumption of coffee in the United States had increased from 8.9 pounds per capita in 1919 to 12.7 pounds per capita in 1920. It was claimed that 1921 will show a still further increase, and a shortage with much higher prices when the European demand is normal was predicted. In various other commodities, particularly canned goods and coal, the probability of a serious shortage this winter is becoming more definite.

An attempt to bring about an agreement to reduce the production of plantation grown rubber is reported from London. Its success seems probable, in which case higher prices would be the natural result. The experts of the grain trade are in disagreement as to the probable course of prices. Many of them predict an advance upon the theory that more than half our exportable surplus of wheat has already been sold. As yet, however, the expected advance has not occurred but some usually well informed people are buying both wheat and corn with confidence.

A further gain in railway traffic is reported and the August earnings thus far published show a striking increase in the net despite a reduction in the gross. The F. W. Dodge Co. reports that the building contracts awarded in twenty-seven Northern States during the week ending Sept. 15 amount to $69,505,700, which is a record for the year.

But it is unnecessary to go into further detail. Almost without exception the indicia of our domestic trade are encouraging and the probability is that Secretary Davis is right in announcing that "Prosperity is at Hand." There was never any occasion for the propaganda of pessimism in which so many joined six months ago and I take not a little satisfaction in having persistenly opposed it.

There are, however, a few clouds upon the horizon. They are not large but they should be watched. One is the Senate tax bill. Many of its provisions and some of its omissions will hamper business by an unequal and unfair distribution of the burden of taxation. Another is the bonus bill whose ultimate passage Congressman Fordney promised in a speech he made in Michigan when he was at home looking after his political fences. The bond issue involved in the passage of a bonus bill would be fatal to the business revival now commencing.

Still another is a possible railway strike. The men are said to have voted in favor of it but the labor leaders seem disinclined to order it. They are wise but they should be watched.

Then there are other clouds across the Atlantic. The darkest is the continued decline in marks which sold as low as 89⅝ cents per 100 last Wednesday, when it became known that the German bank statement showed that 81,469,115,000 marks were in circulation. It is, of course, impossible that this inflation can continue but just how it will be ended and what effect the ending will have upon the rest of Europe and business in this country is a question that the careful man should carefully consider.

The news from abroad is not otherwise disturbing. Lloyd George has undoubtedly checkmated de Valera, and the sharp advance recorded in the price of Mexican bonds is distinctly auspicious.

A recognition of Obregon by our Government and an agreement to reduce armament at the Congress that is to meet in Washington next November are two possibilities either one of which, if it became a reality, might easily fire the speculative imagination of our people and hasten the boom for which we have been psychologically and financially prepared by our large oversupply of gold.

Third Annual Convention and Exhibition of American Society for Steel Treating, at Indianapolis

It is doubtful if any convention ever held was more productive of results than was the one held by the American Society for Steel Treating at the Fair Grounds, Indianapolis, Ind., during the week of Sept. 19. Over fifteen hundred delegates were registered, representing practically every concern of importance in the metal-working and machine-building industry in the United States. Added to this were about eight thousand executives and others interested in the processes and equipment of steel treating, bringing the total registered attendance to nearly ten thousand.

The great number of papers presented necessitated simultaneous sessions during three days of the convention, besides which a number of papers were presented by title only. These papers will be published later in the official organ of the society.

The convention opened on Monday afternoon with an address of welcome by W. R. Chapin, chairman of the executive committee of the Indianapolis chapter. He was followed by Claude S. Wallin, secretary to the Mayor of Indianapolis, who spoke in behalf of the city. Col. A. E. White, whose term of office as national president of the society has just ended, responded for the Steel Treaters. Reports of the tellers of the election of officers followed; also reports of the secretary and treasurer.

The following officers were elected for the coming year: F. P. Gilligan, of Hartford, president; F. C. Lau, Chicago, first vice-president; R. J. Allen, Springfield, Mass., second vice-president; J. V. Emmons, Cleveland, treasurer; J. J. Crowe, Philadelphia, director.

On Tuesday evening the Indianapolis chapter provided a smoker and entertainment for the delegates and guests. On Wednesday evening the annual reception and dance was held in the Claypool Hotel. A fifty-mile race between Duesenberg, Peugeot and Frontenac automobiles was a feature of the Wednesday afternoon program. Howard Wilcox driving the Peugeot was the winner, covering the fifty miles in 30 min. 50:64 seconds. Jimmie Murphy took second place in the Duesenberg, and Jules Ellingboe, in the Frontenac, was third. The occasion was marred to some extent by an accident when one of the cars went over the edge of the track and landed about a hundred feet away. Fortunately, neither driver nor mechanician was severely injured.

Thursday evening the annual banquet of the society was held at the Claypool Hotel. Doctor Albert Sauveur, of Harvard University, was toastmaster. The speakers and their subjects were as follows: A. A. Potter, Dean of Engineering at Purdue University, "The Engineering Society and Public Service"; Comfort A. Adams, director of engineering division, National Research Council, "Co-operation in Engineering Research"; E. A. White, former president of the society and now of the faculty of the University of Michigan, "What the University Owes the Industries."

The principal speech of the evening was delivered by Howard Coffin on the subject of "Our Air Policies and the National Defense." Governor McCray and Mayor Jewett each spoke briefly. E. P. Hyde, director of research for the General Electric Company, told where various kinds of research should be carried on. During the evening the secretary announced that Dr. John A. Matthews, of Pittsburgh, and Elwood A. Haynes, of Kokomo, had been elected honorary members of the society.

Some eighty exhibits were shown in the Manufacturers' Building, including various kinds of furnaces for use in the treatment of steel; compounds and materials for case-hardening and carburizing; insulating bricks, cork, powder and other refractories for use in building ovens and furnaces; heat-insulating cements for banding firebricks, blocks and granular refractories; high-speed, carbon and alloy-steels, together with products made from them; drop-forgings and die-formed parts; products made from bakelite and raw-hide; heat-resisting alloys; metallographic equipment, metallurgical microscopes an other equipment for metallurgical research; pyrometers and temperature control equipment and process timing and signalling instruments; job-time recorders and time-stamps; hardness testing instruments; cutting-off machinery, pumps, grinding and polishing machines and blowers. Several Indianapolis automobile manufacturers also exhibited a line of pleasure cars and commercial trucks.

Balfour Before Senate Finance Committee

Such interest has been manifested in the recent testimony of Arthur Balfour, of Sheffield, England, before the Finance Committee of the U. S. Senate that the following extracts are reprinted from the stenographic report of the hearing, which just has become available:

Senator McCumber. Will you kindly state your name in full, your residence, what interest you represent, and to what you desire to direct your remarks?

Mr. Balfour. My name is Arthur Balfour; I am of Sheffield, England. I am deputy president of the Association of British Chambers of Commerce. I am ex-president of the Sheffield Chamber of Commerce; ex-master cutler of Sheffield, and managing director of Arthur Balfour & Co. (Ltd.), of Sheffield.

I am desirous of drawing your attention to the question of high-speed steels and other steels which have been imported from Sheffield for a great many years.

I am sure you will understand that we feel that we are in a rather delicate situation. We do not for one moment desire to appear to suggest in any way what you should do in your own country; but, owing to the very long time that Sheffield has been associated with America we ventured to come here and put a few considerations before you.

The industrial and commercial conditions in Sheffield created by the war, and in England in general, are very disastrous. We have about 2,000,000 people out of employment. We have another two or three million working only two days a week and a further million working only three days a week, and we are right up against the economic law, owing to conditions created by the war. Sidney Robinson who is with me, represents the firm of William Jessop & Sons (Ltd.). They have been doing business here since 1828.

Mr. Macgregor represents the firm of Sanderson Bros. & Newbould (Ltd.). They have been doing business since before 1829. John Cecil Ward, of Edgar Allen & Co. (Ltd.), and my own concern have been trading here since 1876. We have been in the closest co-operation with the steel makers in this country. During this period we have worked out inventions together and sent workers over here, and in most of your steel firms you will find old Sheffield steel workers today, or their descendants. We are very anxious that these beneficial conditions shall not be disturbed.

Mushet steel, manganese steel, stainless steel, and other varieties, all of which are produced here at the present time, were invented in Sheffield. The Taylor-White process of treating tool steel which has been a very great factor in the trades which we represent, was invented in your country. but as regards the making of high-speed steel, it was perfected in Sheffield.

The population of Sheffield today is over half a million, of which a hundred thousand workmen are largely skilled. We also represent Messrs. Sir W. G. Armstrong, Whitworth & Co. (Ltd.), of Manchester, who make the same class of steel, but it is made in Manchester and not in Sheffield. Taking into consideration their employees, which amount to probably 25,000, we represent about 125,000 workers.

We have also had long personal connections with this country, which has induced us to venture to come to see you. I molded car wheels in Buffalo for four years, from 1892 to 1896. I have been here twenty-seven times. Mr. Robinson has been here forty-three times, and my other colleagues over twenty times. We are all of us local taxpayers, through firms in which we are interested, and all of us employ labor in this country.

We should have liked if it were possible to have no change in the tariff at all. We recognize that that is not possible, and we are prepared to accept the data and proposals made by Mr. Smiley (speaking for the committee of fine steel importers) recently. These gentlemen distribute our products in this country.

Senator Smoot. Take the steel valued above 40 cents per pound. The bill as it passed the House provided 20 per cent ad valorem. That is where the high-speed steel falls. As I remember it, Mr. Smiley wanted 10 per cent instead of 20 per cent.

Mr. Balfour. Yes, sir. Taking paragraph 305——

Senator Smoot. No; that is the first of paragraph 304. Three hundred and five is the paragraph providing 72 cents per pound on the tungsten content in excess of 1¼ per cent, "and 72 cents per pound on the tungsten content in excess of 1¼ per cent shall be levied, collected, and paid on any articles containing molybdenum and tungsten."

So, for high-speed steel, you have got to take pargraphs 304 and 305.

Mr. Balfour. In conjunction.

Senator Smoot. It has been suggested, although not by Mr. Smiley, that the 72 cents be cut to 50 cents. Others have suggested that in their testimony. In other words, they were content with making paragraph 304 10 per cent instead of 20 per cent, and cutting 72 cents to 50 cents per pound on the tungsten contained in the steel.

Mr. Balfour. We suggest that the tungsten should be cut to 35 cents from 72 cents.

Senator Smoot. That is what I wanted to find out. You want 35?

Mr. Balfour. Thirty-five instead of 72.

Senator Smoot. And 10 per cent instead of 20 per cent?

Mr. Balfour. Ten per cent instead of 20 per cent; yes, sir.

At the present time, as you have all heard, the fine steel importation is only 2 per cent of the whole; and we feel that that is a very small percentage and, at the same time, a very useful percentage, as it makes an incentive to the manufacturers here and a great incentive to us to give the best value we can as regards quality and price.

We are satisfied that if the tariff went through as it is at present written it would put us out of business. There is no question about that. I understand that it is not your desire to put anybody out of business entirely; but we could not possibly send you steel under that tariff.

Senator McCumber. What you mean is that it would be prohibitive so far as the American trade is concerned?

Mr. Balfour. It would be absolutely prohibitive, sir, because the duty would come to about 200 pounds per ton, in pounds sterling; and as we have to keep stocks in this country from 50 to 100 tons, we will always have to lock up 20,000 pounds sterling in duty alone on our high-speed steel before we could trade at all.

There is another view which bears very strongly on the amount of the tariff. That is the valuation question. We have got along very well under the present valuation. We are in very close touch with the representatives of your Treasury Department in London. They come to Sheffield to see us and we give them every possible facility for looking into matters, and we have always been able to satisfy them exactly as to what we have been doing.

We desire to go on doing that. We are very anxious that the valuation should be fixed in some way so that we can quote a price fixed to our customers in this country; else it is almost impossible to conceive that your buyers here will give us an open order on a price which is indefinite.

If the valuation is put on the basis it has been suggested, it will be almost impossible for us to say on any given day what duty we shall have to pay and what price we can guarantee to our customer here

Senator Smoot. You must take into consideration that you have an advantage in the exchange value that you have never had before; and this committee has to take that into consideration in fixing these rates.

Mr. Balfour. I agree; I quite appreciate that. We have the same exchange difficulties that you have, somewhat intensified with the competition which we have so close to us in Germany.

Senator Smoot. You know something about that.

Mr. Balfour. We know all about the exchange difficulties; but we do put before you for consideration the difficulty of trading on an open indefinite situation of the kind which this new valuation will create. We also have contracts here with some of your big tool makers for steel, which are running contracts for two or three hundred tons. They want to fix a price that is definite in order to be able to fix their costs of production. Under this system it will be almost impossible for either of us to do that.

Senator Smoot. I cannot agree with you there, because it seems to me that your price under the existing tariff law is fixed upon the day of the exportation. If changes in price should occur in England during that time, of course the rate of duty imposed today will be different. The American valuation does not fluctuate any more than the valuations in a foreign country fluctuate.

Senator McCumber. They are probably more stable now, because the currency is more stable.

Mr. Balfour. I quite agree with you that upon tonnage steel it is a fixed thing. It is a fixed market question. But take high-speed steel and these fine steels, and it is not fixed. They have a different composition, a different analysis, and each concern makes a separate quality. They are not standard.

Senator Smoot. But that same difficulty, if you call it a difficulty, exists today with the foreign valuation.

Mr. Balfour To some little extent, but nothing like to the same extent, because we can today make the price and fix the price in cents.

Senator Smoot. We have a fixed price in America, too.

Mr. Balfour. I only ask you to consider these points and see what you can do with reference to these difficulties.

Senator McLean. On the tungsten content the rate is specific.

Mr. Balfour. The rate is specific on the tungsten content, but there is also an ad valorem percentage on the price.

Senator Smoot. All that the question of American valuation affects is the ad valorem duty of the steel above 40 cents.

Mr. Balfour. We are all in agreement on that. High-speed steel is our important product which we have to send to this country. We are also interested in carbon steel.

Senator McLean. Do you manufacture high-speed steel in this country?

Mr. Balfour. No; none of us. We only manufacture it in England.

Senator McLean. You said you had branch interests here.

Mr. Balfour. Jessops have a company at Washington, Pa., where they roll sheets. The others of us have branches in different parts of the country—Chicago, Boston, and New York.

Senator Walsh. I suppose your ownership is associated with Americans?

Mr. Balfour. Yes, sir. They are practically retailing companies, with the exception of Jessops.

We, of course, are very much interested in the export of finished tools from this country which are made from our steel. We buy large numbers in England and great number are sold to the colonies.

We feel that this tariff will certainly put a difficulty in the way of the export of those tools, as it will further depress the exchange and further accentuate the exchange difficulty, and also make the cost of the high-speed steel to the makers here very much higher, particularly in view of the duty on tungsten.

And if you will allow me to say a word on tungsten, I would like to say that we had during the war great difficulties with tungsten, just as you had; but, fortunately, we had the tungsten in the British Empire, as you had it in your country, and the fact that we had a supply in the British Empire saved us a great deal during the war and enabled us to produce munitions, and we are anxious, from our side, to retain a certain amount of tungsten in the British Empire and not work it all out.

Senator Watson. What are your imports to this country of high-speed steel, as you class it?

Mr. Balfour. They have varied enormously. Recently it has been perhaps 500 to 700 tons per annum, something under 1,000 tons.

Senator McCumber. What was the value?

Mr. Balfour. About £250,000 sterling or something of that kind, roughly.

Senator Walsh. What is the unemployment in England? Some figures which have been given us show that it is about 5 or 6 per cent.

Mr. Balfour. We have 2,000,000 unemployed; we have another million employed two days and several other millions employed three days. Our population is about 45,000,000.

Senator Watson. For the entire year of 1920, under the classification of steel by whatever process made, containing alloys, such as nickel, cobalt, vanadium, chromium, tungsten, or wolfram, molybdenum, titanium, iridium, uranium, tantalum, boron, and similar alloys, we imported 883,740 lb., valued at $371,147.

Mr. Balfour. That would be about right. There are about 250,000 of high speed, and the rest would be made up of other steels.

Senator Watson. How much of that comes from Sheffield?

Mr. Balfour. It practically all comes from Sheffield. A little comes from Manchester. Sweden sends practically no crucible steel and no high-speed steel to this country.

Senator Smoot. I suppose half of that amount would be imported into the United States even though the rates were higher than they are here?

Mr. Balfour. Unless the selling price is too high. I do not think you can say that we have ever ruined the price in competition with the American makers. We have always obtained for our steel at least as good a price, or a little higher, on account of special quality.

Senator Smoot. From the information we receive there are certain industries in this country that would use it no matter whether it cost more than it does now or not.

Mr. Balfour. Yes; even more, but the amount proposed I am afraid would make it impossible to do any export trade.

Senator Watson. What wages do you pay in the making of high-speed steel as compared with the wages paid in this country in the same line?

Mr. Balfour. Our wages have gone up very much since the war. I do not think our wages are very much different from yours at the present time. On the other hand, our fuel, which is a very big factor, is very much higher than yours.

Senator Smoot. What are you paying common labor?

Mr. Balfour. The ordinary common labor, that is, a man wheeling a barrow, gets £3 10s.

Senator Walsh. What is your cost of living as compared with that in America?

Mr. Balfour. I should say your living is a little higher.

Senator Smoot. You have no objections whatever to our imposing a duty equal to the difference in the wage and to equalize the exchange value?

Mr. Balfour. Sir, we have no objection to your imposing a duty. It is for you to decide what it is to be and how it is to be done. We understand all that; but we do ask you, after the pleasant connections we have had together, not to put us out of business.

Senator Smoot. Do you think that the proposition would be a fair one that all that we would impose by way of duty would be the difference in the labor cost and to equalize the difference in exchange?

Mr. Balfour. Yes; provided you made the condition that it should not become a permanent thing; that when conditions altered you would be prepared to reconsider the matter and not, when we have the other conditions right, leave us with a high tariff.

Senator Smoot. Of course you must know that no tariff that will be passed is going to remain on the statute books as they have done in normal times in the past.

Mr. Balfour. We certainly hope not. But we do not believe in retaliation. Whatever happens, we shall give a free entry to your goods as far as it is possible. That I am perfectly convinced of.

Senator McCumber. Let me ask you a question in a little different form from that asked you by Senator Smoot.

Would you be satisfied if we put a tariff on that would measure the actual difference between the cost of production, including everything, in your country and in this country?

Mr. Balfour. Yes, sir; we would, because the cost of production of high-speed steel is less in this country than it is with us. That would suit us entirely.

Senator McCumber. Then, according to that view, there would be no tariff in your mind?

Mr. Balfour. I started my remarks by saying that we should be very glad if everything could remain as it was.

Senator Smoot. Remain as it was?

Senator Watson. Have you prepared production costs to show that it costs less to make high-speed steel in this country?

Mr. Balfour. We have great difficulty in giving you production costs of your own people. We know what our costs are. We are constantly giving them to your representative in London.

Senator Walsh. What percentage do your companies ship to America?

Mr. Balfour. I should say a little less than 20 per cent—probably 18 per cent.

Senator Walsh. Assuming that this tariff amounted to an embargo; your reduction would be only 18 to 20 per cent?

Mr. Balfour. But it does not quite work like that. It is not distributed evenly over the trade. We have some gentlemen whom I am representing who do their whole trade with America. I can put my hand on two or three firms that would go clean out of business. Other firms will be hit more or less hard according to the percentage that affects their own trade.

Senator Smoot. You spoke of having this on the free list.

Mr. Balfour. No, sir. Under the same conditions as exist at present, 15 per cent ad valorem. I said no change in the tariff as it is at present.

Senator Walsh. Do you mind giving us the names of firms or tell us the product produced that would be put out of business?

Mr. Balfour. I can give you that at once. The firm of S. C. Wardlow, who manufacture cutlery steel, would be practically put out of business.

Senator Walsh. Can you give us any others?

Mr. Balfour. I can give them to you afterwards.

Senator Walsh. Do they also make cutlery?

Mr. Balfour. There are also other firms who make cutlery and high-speed steel.

Senator Smoot. The average price of high-speed steel in Britain today is about $200 a ton?

Mr. Balfour. Four hundred and twenty pounds a ton is the price of 18 per cent high-speed steel today, f.o.b. England.

Senator Smoot. Thank you; that is all I care for.

World Engineering Council Proposed by Sir Robert Hadfield

A world engineering council of Anglo-Saxons is advocated by Sir Robert A. Hadfield, British scientist and engineer, who in a message to the engineers of America invokes the principles of Gladstone to promote unity among English speaking peoples.

Sir Robert's message, made public at the headquarters of the national engineering societies in New York City, pledges the support of British engineers to the new movement for international co-operation which is to be formally set in motion at a dinner in New York on Oct. 10, when the return of the mission of thirteen sent abroad to confer the John Fritz medal upon Sir Robert and Eugene Schneider, of Paris, will be celebrated.

Sir Robert, upon whom the John Fritz medal was bestowed because of his achievements in the development of manganese steel, asserts that all communities of British origin must forever stand together as they did in the World War for the defense of their common civilization.

Voicing, he says, the opinion of British engineers, Sir Robert asserts that the engineers of Great Britain and America are going to pull together. He advocates the federation of the engineering societies of the entire British Empire with an executive council similar to the American Engineering Council of the Federated American Engineering Societies. He proposes further the establishment of a "General Engineering Council for Anglo-Saxons throughout the world," adding:

"Such a council would indeed be fraught with great prospects for the future of the human race. Engineering does not lend itself to politics or diplomacy, but engineering of all kinds lends itself to improving human effort and helps on in a very high degree of the march of civilization."

Sir Robert cited the work of Robert Stephenson, Sir Benjamin Baker, and Thomas Telford as illustrating the contributions to the world's progress made by engineers in railroad, highway building and bridge construction. The harnessing of Niagara he called a noble feat of American engineering.

Tribute to Lloyd George

Sir Robert said that the British do not pretend that it was they who won the war. The last war, Sir Robert said, was largely an engineering war. He paid a striking tribute to Premier Lloyd George for recognizing this. "There was no one, I think," said Sir Robert, "who better saw and understood the enormous importance of British engineering and what it was going to stand for in the war than our present Prime Minister, whose name will justly go down through the ages for what he did in those early days of the war in organizing and energizing the engineering capacity of this country. He quickly realized it was to be largely an engineering war."

Calvin W. Rice of the American Society of Mechanical Engineers is charman of a committee which is arranging for the international celebration at the Engineers Club in this city next month. Engineers representing the Allied nations will attend. Invitations have been extended to many men prominent in diplomacy and public life on both sides of the Atlantic.

Executives Comment on Business Revival

Opinion of well-informed executives in the metal trades is that business and industrial betterment will gain ground during the fall. This is already reflected in the strengthened undertone of the iron and steel industry.

The *Public Ledger*, of Philadelphia, Pa., prints the following interviews by prominent industrial managers:

Gustave Kahn, vice president in charge of sales of the Truscon Steel Co., states the greatest ebb in depression is now a matter of history and improvement is gaining. He declares that determination in salesmanship and an unfailing faith in ultimate results are factors which will have an important bearing on future improvement in business.

Shirley S. French, vice-president and general manager of the General Fireproofing Co., says that demand for inside fireproofing materials is steadily expanding. This follows the building season, when dwellings and business blocks are coming to the point of completion and the demand for lathing and other fireproofing materials is proportionately benefited.

L. J. Campbell, president of the Electric Alloy Steel Co., states the business in August showed improvement over July and the outlook is for continued betterment. The company's rolling mill at its Charleroi, Pa., plant has resumed after a prolonged suspension.

Fred B. Kanengeiser, general manager of the Bessemer Limestone and Cement Co., points out that the company's cement plant at Bessemer, Pa., exceeded in August the July record production, and that August shipments of 100,000 barrels established a new shipping record.

J. B. Kennedy, chairman of the board of directors of the Brier Hill Steel Co., looks for a gain of 10 per cent in business during the last quarter of 1921. He predicts that the industry will be operating around 60 per cent of normal, as a whole, by the middle of 1922.

Copper and Tin Deposits in Dutch East Indies

Since the discovery of rich copper deposits near Taninj in South Timor, Dutch East Indies, extensive exploring and developing work has been carried on, states the *London and China Express*. In view of the miscellaneous machinery and hand tools arriving at the mines, and the numbers of workmen engaged, it is believed that the deposits are gaining in importance. It is also stated that in the neighboring district tin has been discovered equal in richness to any yet found in the island of Banka. This should lead to important development and opportunities for supplying plant and machinery.

General Motors To Concentrate Export Manufacture

The "efficiency plan" recently adopted by the executive committee of the General Motors Corporation is getting well under way, according to a statement just made by the General Motors Export Co. to its employes. The "back-to-the-plant" movement, which was started some time ago, called for the transfer of all of the leading operating officials from New York direct to the various manufacturing centres.

In announcing its plans for the export company the General Motors Corporation states that all those associated with the export company are familiar with the fact that there is more or less difference between the necessities of car manufacture from the export standpoint as compared with the domestic standpoint, and for that reason it has been decided to concentrate the manufacture of all export models, with the exception of the Cadillac and General Motors trucks, at the Canadian plant of the corporation, General Motors, Limited, located at Oshawa, Ontario.

As a result of this plan, Paul Fitzpatrick, now vice-president in charge of operations, will be transferred from the export organization and will be made assistant to Alfred P. Sloan, Jr., operating vice-president, with duties pertaining to the transfer of export operations to Oshawa, and the study of all problems incident to such transfer. P. S. Steenstrup, vice-president in charge of sales, will exercise full authority in the export organization, subject to the president.

Testimonial Dinner to Robert L. Crane

On Sept. 8 at the Queen City Club in Cincinnati, a testimonial dinner was given to Robert L. Crane, who has just left Henry Prentiss & Co. to go in business for himself. Those present were Wallace Carrel, of Lodge & Shipley; B. B. Quillen, of the Cincinnati Planer Co.; Fred A. Geier and C. Wood Walter, of the Cincinnati Milling Machine Co.; A. J. Jones, of the Acme Machine Tool Co.; August H. Tuechter and George Gradolf, of the Cincinnati-Bickford Tool Co.; and Arthur Hoefinghoff, of the Cincinnati Grinder Co.

Fred Geier acted as toastmaster and presented Mr. Crane with a Rookwood lamp in token of the appreciation of those present and for his loyal services in the past.

Steel Fabricators To Meet in November

Plans for the annual meeting of the National Steel Fabricators' Association were outlined at a meeting of the executive council of the association at the Waldorf-Astoria on Sept. 20. It was decided to hold it in Pittsburgh the first part of November. The meeting will be held early, owing to the vital importance of topics, which will be brought up, among them being the freight rates, labor and material costs and plans to stimulate sales.

By unanimous vote of the council, H. B. MacMasters, of Canton, Ohio, was elected executive secretary of the association. Mr. MacMasters will assume his duties at the offices of the association, 50 Church St., immediately.

Chapman Co. To Manufacture Safety Nut

Plans for the establishment of a plant for the manufacture of a patent railroad nut, for use on tracks, are being made by the Chapman Self-Locking Nut Co., 721 Equitable Building, Baltimore, Md. Papers of incorporation of the company, with capital stock of $1,000,000 are being prepared and it is announced that they will be filed in the near future.

The nut is the invention of H. D. Chapman, of Baltimore, and tests through which it has been put on the Canton Railroad, Baltimore, are reported to have proved decidedly successful. The tests have covered several weeks and the nuts have remained exactly as placed at each joint, even the compromise joints.

The invention consists of a slit placed in the nut, which is then jammed. When it is screwed upon the bolt it remains exactly at placed.

Legal Help for U. S. Manufacturers Abroad

The Division of Commercial Laws of the Department of Commerce is compiling names of attorneys practicing in foreign countries who have been recommended by some trustworthy source as competent in their profession and in a position to care properly for American interests. These names will be given to American business houses and to their counsel when in need of the services of legal advisers in some particular foreign locality, but will not be supplied as lists for general information. It must be understood by those who apply for this information that these names are furnished on request, and without any responsibility to the Bureau, as a convenience to inquirers. It will be generally possible to indicate the sources by which the various attorneys have been recommended, but, of course, without any responsibility being assumed by authorities so quoted.

Navy Yard Pay to Stand

That the ruling of the Secretary of the Navy in reducing the wages of Navy Yard workers will stand was indicated by the fact that the matter was not even discussed at the Cabinet meeting on Sept. 20. It had been heralded widely by the Navy Yard employees that the matter was to be taken up at the Cabinet meeting on that date.

Representatives of the employees have been very active in bringing the matter to the attention of Cabinet members, Congressmen and the public. Pressure for a review of the wage decision is being brought in numerous quarters, particularly from the communities in which Navy Yards are situated.

Iron and Steel Boom in South

While pig iron production in Alabama during August amounted to only 72,699 tons, it is confidently expected by leading men of the industry that by Oct. 15 the state will be producing at a pace of 100,000 tons per month because of the steady improvement in iron and steel conditions throughout the country during the past few weeks.

Of the Alabama August production 17,291 tons were of merchant iron, or foundry product, while the balance, 55,408 tons, was basic iron. Production during July was only 66,573 tons, an improvement of more than 6,000 tons being shown for August because of steady improvement in conditions.

The Central Iron and Coal Co. resumed operations in mid September at its furnace at Holt, Ala., and at 40 of its 60 by-product ovens. The Kellerman Coal Mines, from which the company draws its main coal supply, will resume late in September. The furnace has been idle for almost a year, and the merchant iron the company had in the yards when it was shut down had been entirely exhausted.

The North Birmingham furnaces of the Sloss-Sheffield Co. are being cleaned up and overhauled preparatory to resuming in the near future. The Alabama Co. will resume at one of its furnaces at Gadsden, Ala., Oct. 15.

The Woodward Iron Co., now operating the only two furnaces in the state that are making foundry iron at this time, is preparing to resume at its third furnace in Woodward within the next month or so.

The furnaces of the Republic Iron and Steel Co., at Thomas, Ala., will also probably resume shortly.

The Gulf States Steel Co., and the Tennessee Coal, Iron and Railroad Co. also are expected to resume operations at some of the furnaces before the end of the year.

Nail making departments of the various wire drawing mills in the South are mostly operating at near capacity because of an increased demand for these lines the past few weeks.

Business Items

L. C. Biglow & Co., Inc., 232 West 55th St., New York City, has been appointed New York district agent for the Hartford Tap and Gauge Co., the Hanson-Whitney Machine Co., Inc., the Taylor & Fenn Co. and The Whitney Mfg. Co., all of Hartford, Conn. As New York agents for these concerns, L. C. Biglow & Co. will handle taps of all kinds and plug thread gages of greatest accuracy; also grinding machines, milling machines, vertical die shaping machines, centering machines and automatic thread milling machines. They will also handle a full line of roller, block and silent types of chain and Woodruff keys.

Production of steel ingots, Pittsburgh district, during August is reported to have been 30 per cent of capacity as against 21 per cent capacity production during July. Low mark was about July 15, when production fell below 20 per cent capacity.

U. S. Department of Commerce has appointed following heads of reorganized geographical divisions: Eastern Europe, E. Dana Durand; Western Europe, Allan G. Goldsmith; Latin-America, Thomas R. Taylor; Near East, James A. Robertson; Far East, Frank R. Eldridge. Commodity experts have been named by the department for each of thirteen important industries, and others are to be appointed.

According to data collected by National Federation of Iron and Steel Manufacturers, wages in British steel industry were at peak in September, 1920. On June, 1920, base as 100, wages were then 107, but employment had fallen to 14.2 per cent of June, 1920 figure, the coal strike being principal cause. By May, 1921, wages had fallen to 65 per cent of June, 1920 rate.

Cleveland investors have organized the Ohio Steel Castings Co. to take over the Cleveland plant of the Aetna Steel Castings Co., which went into bankruptcy about six months ago. The Aetna also has a plant in Lorain. The Ohio Steel Castings Co. has been incorporated under Ohio laws with a capital of 1,000 shares of no par common stock. Incorporators are, John W. Thompson, president and treasurer; Dr. C. S. Fenton, vice-president; Harry Greshen, general manager; John A. Elden, secretary and counsel and W. I. Thompson.

The Batterman-Truitt Co., of Chicago, Ill., manufacturer of ventilating, heating and drying apparatus, has changed the company name to Autovent Fan and Blower Co. There has been no change in the personnel of the organization or in the product manufactured.

The Richard French Iron Works, of Worcester, Mass., has purchased a tract of land in Millbury, Mass., where a new and modern factory will be erected.

The Air Compressor and Equipment Co. has been incorporated at Portland, Ore., to manufacture and assemble air compressors. Directors are G. S. Malcolm, G. Larrobee and W. E. Thomas.

The Vac-Line Engineering Co., has been incorporated at Dover, Del., to design and build motors. Capital stock is $100,000.

Notice has been received of the recent organization of the Franklin Tool Sales Co., at Indianapolis, Ind. The new company will market all kinds of cutting tools, gages, jigs and fixtures and other machine shop equipment. F. R. Beltz is general manager.

The Roxbury Steel Castings Co., has been incorporated at Boston, Mass., with a capital stock of $50,000. Incorporators are I. E. Sexton, A. Sexton and P. C. Rogers.

The Wyckoff Drawn Steel Co., of Ambridge, Pa., is constructing a new plant, to cost approximately $60,000. This addition is being added to take care of increased business.

The Gary Motor Truck Co. and the Chase Tractors Corporation, both of Toronto, Canada, will be merged into one concern as soon as the necessary papers are completed. The combined capital stock will be $2,000,000.

The Wopeco Machine Co., New Haven, Conn., has been incorporated to manufacture and sell can-opening and shear grinding machines. G. H. Woodruff, W. S. Perry and J. W. Comerford are directors.

The Stovall Manufacturing Co., has been incorporated at Port Angeles, Wis., capital stock $150,000, to manufacture machinery, tools, etc. U. M. Stovall, H. Machenheimer and F. L. Plummer are directors.

The G. F. Wright Steel and Wire Co., of Worcester, Mass., has purchased the old plant of the Standard Plunger Elevator Co., at Jamesville, Mass. A corporation will be formed and the plant put into operation at once.

Reorganization and incorporation of the recently combined forces of the Massillon Rolling Mill, Central Steel Co., and the National Pressed Steel Co., all of Massillon, Ohio, has been completed. The capital stock is announced as $10,000,000. The consolidated company will do business under the name of Central Steel Co. R. E. Bebb, president of the old Central company, will be in charge of the new organization.

Durant Motors, Inc., has announced in New York that the Ansted motor, manufactured by the Ansted Engineering Co. at Connersvile, Ind., has been adopted for use in the Durant six-cylinder car, which will be ready for the market Nov. 1. A statement by W. C. Durant is to the effect that Durant Motors will have the exclusive right to the use of the motor.

Personals

Hans Renold, of Manchester, England, maker of the famous chains that bear his name, has been visiting this country with his son to get a line on business conditions.

F. B. Mullin, former superintendent of the Willys-Overland plant at Elyria, Ohio, has been named to look after the work formerly handled by H. J. Edwards, who recently resigned as manager. Production is being increased rapidly.

Charles W. Young, of New York City, has been elected president of the Kelly-Springfield Motor Truck Co., Springfield, Ohio which recently severed its connection with the Hare Motors Corporation. Ed McDonnell, of New York, has been named general manager.

Robert S. Fowler, formerly assistant sales manager of the Northway Motor and Manufacturing company division of the General Motors corporation, and prior to that with the Anderson Electric Co., has

been appointed district representative of the Wheel Trueing Tool Co., Detroit.

D. L. Morgan, New Haven, Conn., has been appointed executive chairman of the American Automobile Association to succeed the late A. G. Batchelder. Mr. Morgan has been holding the temporary appointment, pending action of the A. A. A. board which was taken Monday. Formerly, Mr. Morgan was active in the affairs of the Pennsylvania Motor Federation and the New Haven Automobile Club.

Barnard Eberlin and M. L. Filley have organized Filley & Eberlin, New York, and will act as district sales agents for the Sueprior Sheet Steel Co., of Canton, Ohio.

George P. Hansen, formerly in charge of blast furnaces for the Republic Iron and Steel Co., at Youngstown, Ohio, has been appointed superintendent of the blast furnaces for the American Rolling Mill Co., at Columbus, Ohio.

Robert L. Crane for twenty-three years western New York manager of Henry Prentiss & Co., Inc., has terminated his connections with that company but will continue in the same line of business under the name of Crane Machinery Co. with offices at 501 D. S. Morgan Bldg., Buffalo, N. Y. Mr. Crane is now establishing selling connections with a view of establishing branch offices in Rochester, Syracuse and Albany.

F. R. Beltz, formerly president and manager of the Indian Tool and Supply Co., and at one time tool buyer for the Nordyke & Marmon Co., has been appointed general manager of the Franklin Tool Sales Co., recently organized at Indianapolis, Ind.

D. D. Lewis, former manager of Tom L. Johnson's steel plant in Lorain, has been appointed general manager of the Carroll Foundry and Machine Tool Co. of Bucyrus, Ohio.

Frank E. Knickerbocker, formerly in charge of the Flint branch of the Samson Tractor Co., is in charge of a newly opened Oldsmobile branch factory in Lansing. From this branch also, J. W. Rapley will handle general distribution for Michigan.

Obituary

David N. Wilson, Jr., consulting engineer for many years with the Erie Railroad, died at his home in New York City on Sept. 15. Mr. Wilson was the inventor of the welding machine which was used to repair the broken cylinders on the interned German ships during the war.

Albert R. Crittenden, vice-president of the Wilcox-Crittenden Manufacturing Co., Middletown, Conn., died on Sept. 15. He was seventy-six years old.

J. J. Davin, manufacturer of oil-well tools, died at his home in Washington, Pa., on Sept. 11. He was seventy-three years old.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

An agency is desired by a mercantile company in France for the sale of refrigerating machinery. Quotations should be given c.i.f. French port. Correspondence should be in French. Reference. No. 69.

A planter in Angola, South-west Africa, desires to purchase machinery for preparing coffee and palm oil, and also one or two trucks. Quotations should be given c.i.f. Novo Redondo, or Benguela Velha. Correspondence should be in Portuguese. Reference No. 70.

A merchant in Chile desires to purchase electrical goods and motors, automobile accessories, phonograph records, electric lamps and supplies and parts, and electric-light bulbs of 220 and 110 volts. Quotations should be given c.i.f. Talcahuano. Correspondence should be in Spanish. Reference No. 58.

A mercantile firm in France desires to purchase automatic machinery for forging and manufacturing files. Quotations should be given c.i.f. Bordeaux or Havre. Cash to be paid. Correspondence should be in French. Reference No. 64.

A firm of automobile dealers in Spain desires to purchase and secure an agency for the sale of gasoline, air, and oil pumps for use in garages. Quotations should be given c.i.f. Spanish port, or f.o.b. New York. Payment to be made against documents at Spanish port, or in New York. Reference No. 53.

A retail dealer and owner of general stores in Chile desires to purchase machinery and hardware. Quotations should be given c.i.f. Talcahuano. Correspondence should be in Spanish. Reference No. 55.

A mercantile firm in Chile desires to secure an agency for the sale of hardware, iron and steel. Quotations should be given c.i.f. Talcahuano. Correspondence should be in Spanish. Reference No. 46.

An American exporting firm having connections with importers in North Borneo desires to secure an agency for the sale of steam engines, portable one-man saws, light motor trucks, trailers, nails, and motor-boat engines of 12 to 45 horsepower. Quotations should be given f.o.b. New York. Reference No. 47.

A commercial agent in the Netherlands desires to secure an agency for the sale of machinery, motors, rubber tires, etc. Quotations should be given c.i.f. Rotterdam or Amsterdam. Reference No. 48.

Trade Catalogs

Drawing and Tracing Papers and Cloths. New York Blue Print Paper Co., 102 Reade St., New York City. A book of samples of drawing papers, tracing papers and cloths, profile and cross-section.

Steel Lockers. Narragansett Machine Co., 52 Vanderbilt Ave., New York City. Circular describing and illustrating a line of steel lockers, wardrobes, shelving and cabinets. Specifications and price lists are furnished for each type.

Michigan Wiring and Fittings. Michigan Stamping Co., Detroit, Mich. Catalog No. 10 describing a line of metal stampings for cabinet boxes, switch boxes, outlet plates and boxes. Tables of measurements showing prices for the various types and sizes are included.

Illinois Tools. Illinois Tool Works, Chicago, Ill. Revised stock list of the company's products which include all types and kinds of reamers, cutters and hobs. Each model is fully described.

Chains and Sprockets. Cullmen Wheel Co., Chicago, Ill. Catalog No. 12 containing a wealth of illustrative and descriptive information on a great variety of sprockets and chains. Tables of chain speeds are included as well as complete specifications of the various types shown.

Automobile and Service Station Equipment. The Fairbanks Company, New York, N. Y. Catalog No. 10-B, illustrating and describing several lines of labor-saving devices and machines handled by this company. Each device is fully described and specifications and other information supplied.

Standard Toolbits. The New England Tool and Machine Co., Inc., Springfield, Mass. A small four-page circular explaining some of the features of the toolbits manufactured by this company, and marketed by the Carlisle Hardware Co., of Springfield, Mass.

GTD Small Tools. Greenfield Tap and Die Corporation, Greenfield, Mass. Catalog No. 46, four hundred 5 x 7-in. pages. A complete list of GTD products including taps and dies, screw plates, drills and reamers, milling cutters and pipe tools. Full descriptions, specifications and price lists are given for each type.

Ajax-Northrup High-Frequency Furnace. Ajax Electrothermic Corporation, Trenton, N. J. The first of a series of bulletins treating of this recent addition to heat-treating appliances.

Milling Cam Turning Lathe. Walcott Lathe Co., Jackson, Mich. A four-page circular illustrating and describing the latest model cam turning lathe produced by this company.

Pamphlets Received

Welding and Cutting. Davis-Bournonville Co., Jersey City, N. J.; written by Fred. E. Rogers. A book of instructions for the care and use of oxy-acetylene apparatus and equipment. The book is fully illustrated with halftones of apparatus in operation, and specifications and drawings are included.

Furnace Conditions for Proper Treatment of Die Blocks. By Dr. S. Trood, (reprinted from "Forging and Heat Treating"). Distributed by Tate-Jones & Co., Pittsburgh, Pa. A description of an automatically controlled oil-fired furnace designed and built by the Tate-Jones Company for annealing and hardening die blocks; it is said to be less expensive than the electric furnaces previously used.

Employees' Instruction Manual. Published by the Bausch & Lomb Optical Co., Rochester, N. Y. A very good sample of a booklet which many companies distribute among their employees. It contains general information on company rules, regulations, wage scales, working hours, etc.

Standard for Testing Welds: Bulletin No. 1, published by the American Welding Society, New York City. A digest of the report of the committee on standard tests for welds of the American Bureau of Welding.

The Variety of Furnace Design: Distributed by W. S. Rockwell Co., 50 Church St., New York City. The third of a series of bulletins dealing with the fundamentals that influence the quality and cost of heated products. It illustrates the relation of type and arrangement of heating equipment to cost of production, and the many factors that must be considered in adapting such equipment to individual manufacturing conditions.

Catalogs Wanted

A manufacturer in Chicago is desirous of receiving catalogs on machinery for the manufacture of bottle caps complete. Those interested may communicate with D. W. Brown, 3017 South La Salle St., Chicago, Ill.

Forthcoming Meetings

The twelfth annual convention of the American Manufacturers Export Association will be held in the Waldorf-Astoria Hotel, New York City, on October 5 and 6. A. W. Willmann is secretary.

The fifth annual convention of the Society of Industrial Engineers will be held at Springfield, Mass., Oct. 5, 6 and 7.

A joint meeting of the American Society of Mechanical Engineers, the Society of Automotive Engineers and the Army Ordnance Association will be held at Aberdeen, Md., Friday, October 7.

The annual meeting of the National Association of Purchasing Agents will meet in the Claypool Hotel, Indianapolis, Ind., on Oct. 10 to 13, inclusive. L. F. Boffey, 19 Park Place, New York City, is secretary.

The American Gear Manufacturers Association will hold its semi-annual meeting at Rochester, N. Y., October 13, 14 and 15. F. D. Hamlin, 4401 Germantown Ave., Philadelphia, Pa. is secretary.

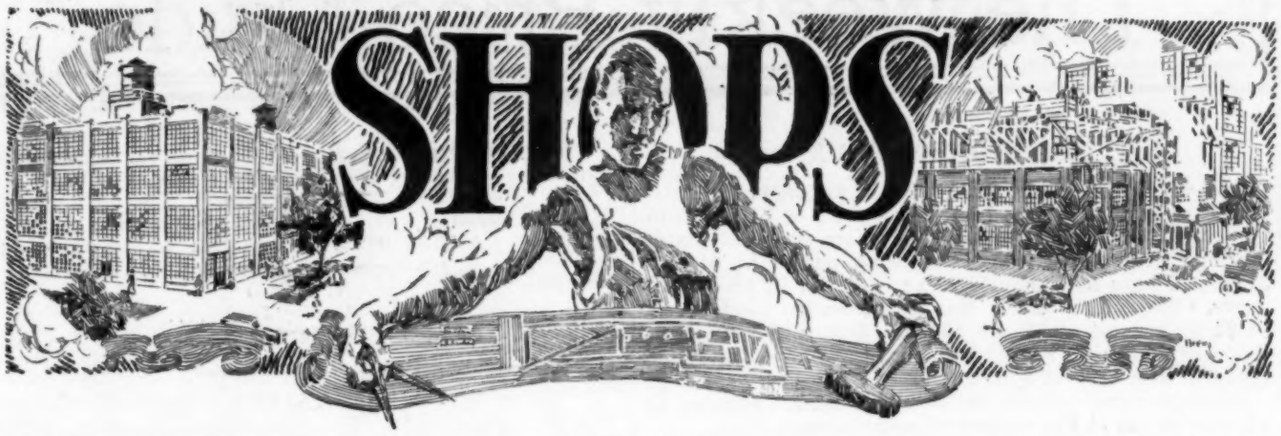
The National Machine Tool Builders' Association will hold its fall meeting at the Hotel Astor, New York City, October 18, 19 and 20.

The annual convention of the Industrial Relations Association of America, will be held in the Waldorf-Astoria Hotel, New York City, on Nov. 1, 2, 3 and 4.

The National Conference of the Industrial Cost Association will be held at Pittsburgh, Pa., on Nov. 2, 3 and 4.

The third annual convention and exhibition of the American Gas Association will be held in the Congress and Auditorium Hotels, Chicago, Ill., on Nov. 7 to 12.

NEW *and* ENLARGED



Machine Tools and Machinery Wanted

Machine-tool wants published without charge

N. J., Newark—The C. & V. Mfg. Co., Inc., 54 Morris Ave.—No. 3 Thurston die milling machine (used if in good condition).

N. J., Newfield—Wilcox-Durand Glass Co. —machinery and tools for machine shop.

N. J., Wildwood—W. Butterfield—lathes for proposed machine shop.

N. Y., Binghampton—E. H. Thatcher & Co., manufacturers of wire goods—wood screw threader.

N. Y., Brooklyn—The Brooklyn Machinery Exch., 559 84th St.—No. 2 Sleeper & Hartley collers.

N. Y., Rochester—Alent Machine Tool Co., 479 St. Paul St., A. Alent, owner—automatic screw machine.

La., New Orleans — The Gravier Auto Storage & Repair Co., 935 Gravier St., C. E. Thomas, Supt.—medium size lathe, vices and wrenches.

Ill., Chicago—The Auto Radiator Specialty Co., 4852 West Madison St.—8 ft. sheet metal brake.

Ill., Chicago—E. M. Heller Co., 144 West Kinzie St.—six lathes, Sundstrand preferred.

Ill., Granite City — The Cabaret Range Co., c/o A. Holloway—machinery for proposed range plant.

Ind., Muncie—Warner Corp., manufacturer of gears—Nacto drill, No. 14 with 22 spindles, and No. 1 Morse taper 3 spindles, 1¼ in.

Mich., Detroit—D. & L. Co., 625 Beaubien St., miscellaneous machine shop equipment including used lathe.

O., Cincinnati—The Pettibone Mfg. Co., 632 Main St., D. Evans, Purch. Agt.—belt driven engine lathe with 6 ft. bed, 14 in. swing.

Wis., Milwaukee—The Fire Ball Spark Plug Co., c/o E. C. Kahn, 4129 Highland Blvd.—several 24 in. drill presses.

Wis., Milwaukee—Safety Wash Stick Co., 758 9th St., J. M. Smaler, Purch. Agt.—polishing machines.

Wis., Milwaukee—Scharf Garage Co., 516 Burleigh St., A. Scharf, Purch. Agt.—drill press for repair work.

Wis., Racine—School Bd., A. H. Schafer, Secy., full line manual training machinery and equipment.

Wis., Racine—C. Stuhr, 1207 10th St.—one 16 in. shaper.

Wis., Saukville—A. Horn—presses, lathe etc. for proposed garage on Main St.

Que., Chicoutimi—Fremblay & Simard, J. E. Oimard, Purch. Agt.—equipment for automobile repair shop.

Que., Montreal—E. Goyette, 803 Laurier Ave., E.—automobile repair shop equipment including medium size lathe.

Que., Montreal—Martel Co., Ltd., 2454 Park Ave.—lathes and vises for repair shop.

Que., Montreal—The Protestant School Comn.. 36 Belmont St.—manual training equipment for two schools.

Conn., Bristol—E. Ingraham Co., 392 North Main St.—double surfacer to be used in connection with a small portable saw mill.

Md., Steyer—The Miners Coal Co., I. G. Mercer, Mgr.—coal mining machinery and equipment.

N. Y., Buffalo—A. J. Ingle, 630 Jefferson St.—printing press with or without type, etc.

N. Y., Rochester — Re-Nu-It Upholstery Co., 413 South Ave., C. V. Quicke, owner —one Universal combination woodworking machine with band saw, cut-off saw, joiner, etc.

Pa., Philadelphia—The City, W. S. Twining, dir., 1211 Chestnut St., will receive bids until Oct. 4 for 2 electric traveling cranes.

Pa., Philadelphia—The Forrest Laundry, 1225 Columbia Ave.—general laundry machines.

Ala., Hartselle—Big Four Ranch Co., W. E. Lynn, Purch. Agt.—complete machinery and equipment for small ice manufacturing plant, also planing machine for hardwood and pine.

La., Willowbrook (Blanchard P. O.)—F. M. Brown, vulcanizing and repairing—equipment and machinery for vulcanizing and repairing automobile tires and tubes.

N. C., Murphy—Eland Mineral Co., Inc., P. O. Box 114—purchase or rent of complete crushing outfit, portable preferred, including crusher 9 x 15 in. or larger, elevator, screen, etc.

N. C., Winston-Salem—The Crawford Mill Supply Co., 438-440 Main St., T. B. Crawford, Purch. Agt.—9 in. moulder, endless belt sander and double and tenoner machine, (used, good condition).

Va., Portsmouth—The Planters Mfg. Co., Inc., manufacturers of fruit and vegetable crates, W. H. Hargroves, 110 Mt. Vernon Ave., Genl. Mgr.—one Derrick boom-swinger, one bushel stave basket stapler, berry quart and till basket machine, twenty thousand ft. No. 1 quality 1 in. black pipe, one thousand ft. 6 in. and 400 ft. of 4 in. cast iron water pipe, fifteen fire hydrants, one hundred ft. gravity conveyor, a 250 hp. electric generator alternating or direct current, short log saw mill, twenty-five hamper forms to make 5 and 8 brace hampers standard size, one boiler, 150 to 200 hp., with 125 steam pressure; one veneer printing press, one knife grinder 76 in. or longer for grinding veneer knives, one veneer clipper 76 in. or wider, two rip saws, power fed gang rip saw, one American automatic cut-off saw, one band rip saw, one planer double surface heavy duty, 2-bu. hamper machines, two chain feed crate side staplers, seventy-five factory trucks, seventy-five roller bearing lumber dry kiln trucks, one Ireland Machine & Fdry. Co. hamper basket bottom saw, one veneer dryer, one water tank, 5,000 to 6,000 gal. capacity.

Va., Wytheville—R. P. Johnson, manufacturers of machinery, O. M. Johnson, Purch. Agt.—Complete coal mining or cutting machinery for 4 ft. soft coal vein.
One 4 to 6 in. molder (used).
One 24 to 30 in. circular resaw (used).
One 8 to 12 in. jointer (used).
One 80 h.p. Economic type locomotive boiler on sills with fittings, smoke stack and usual equipment (used).
One 20 to 25 ton 36 gage saddle tank locomotive (used).
One mile of 70-lb. relaying steel rail with splices, bolts and two switches.
Seven miles of 30-lb. relaying steel rail with splices, bolts and spikes.
One-hundred ton of 35-lb. relaying steel rail without splices and bolts.
Two thousand five-hundred ft. 2½ in. black pipe with good threads and couplings.

W. Va., Wellsburg—Eagle Mfg. Co., manufacturers of glassware — Ingersoll Rand compressor.

Ill., Chicago—G. J. Nickolas & Co., 1227 Van Buren St. (bronze work).—One Japanning oven.

Mich., Detroit—Detroit House of Correction, 1441 Alfred St., J. O. Stutsman, Supt. —One Smith sander (used).

O., Cincinnati—The Queen City Crushed Stone and Gravel Co., Federal Union Insurance Bldg., 9th and Vine Sts., H. P. Lange, Purch. Agt.—steam shovel, ¾ or 1 cu.yd. bucket, steam driven, full revolving, Erie, or Bucyrus preferred.

Wis., Kansasville — The Spring Valley Sanitary Milk Co.—machinery for pasteurizing plant.

Wis., Milwaukee — The Badger State Cabinet Co., 387 10th St., G. Baum, Purch. Agt.—One wood jointer.

Wis., Milwaukee—J. J. Jones Co., 1017 3rd St., H. Goeler, Purch. Agt.—Woodworking machinery to manufacture window screens.

Wis., Neenah—The Valley Paper Mills, East Wisconsin Ave.—paper machines, crane, etc.

Ark., Dean—Steinke Oil & Gas Co., D. Steinke, Pres.—deep rotary rig and well casing, (new or used).

Ont., Parry Sound—Conger Lumber Co. —edger, kicker and roller, board trimmer, re-saw mill.

Ont., Windsor—The Essex Provision Co., Ltd., 1120 McDougall St.—packing plant equipment for proposed plant.

Que., Montreal—J. J. Joubert, Ltd., St. Andre St.—complete equipment for artificial ice plant.

Que., Montreal—J. J. Joubert, Ltd., St. Andre St.—modern and complete equipment for creamery.

Metal Working Shops

NEW ENGLAND STATES

Conn., Danbury—J. McNiff, 85 Main St., has awarded the contract for the construction of a 1 story, 40 x 180 ft. garage and service station on Center St.

Conn., Middletown—C. J. Masin, 545 Main St., has awarded the contract for the construction of a 1 story, 100 x 120 ft. garage, etc., on Main St. Estimated cost, $40,000.

Conn., New Britain—The Lash Motor Co., Lincoln and West Main Sts., plans to build a 3 story garage, etc., on Main St. Estimated cost, $50,000. Architect not announced.

Mass., Winthrop—H. Standard, 43 Tremont St., Boston, plans to build a 1 story garage on Somerset Ave. Estimated cost $50,000. Private plans.

R. I., Providence—Williams & Anderson Co., 33 Broad St., has awarded the contract for the construction of a 1 story, 60 x 100 ft. and 65 x 160 ft. factory on North Main St., for the manufacture of jewelry. Estimated cost, $60,000.

The Weekly Price Guide

This Week's Market

Structural steel shapes are quoted at $1.60@$1.70, Pittsburgh, as compared with last week's price of $1.70@$1.75 per 100 lb. Quotations on soft steel bars and steel plates continue without change, plates being quoted at $1.60@$1.70 and bars at $1.65@$1.70 per 100 lb., in small tonnages. Pittsburgh quotes No. 28 galvanized steel sheets at $4 as against $3.75 per 100 lb. Mill shipments, New York, of structural shapes and plates are quoted at $1.98@$2.03; with bars at $1.88@$1.98 per 100 lb.

Advances ranging from 50c. to $1 per ton are reported in pig-iron prices at the various shipping centers.

Cleveland quotes increased discounts on wrought-steel pipe. A decrease of 50c. on both openhearth and light spring steel. A drop of 35c. per 100 lb. on cold-finished steel shafting, squares, flats, etc., is reported in Cleveland.

New York warehouses quote advances of ¼c. on tin and ½c. per lb. on lead in quantities under carload lots. Linseed oil has advanced 5c. per gal. (5-bbl. lots) in Cleveland.

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	†$24.50
Northern Basic	†22.52
Southern Ohio No. 2	†23.52
NEW YORK—Tidewater Delivery	
Southern No. 2 (Silicon 2.25 to 2.75)	†30.26
BIRMINGHAM	
No. 2 Foundry	†20.00
PHILADELPHIA	
Eastern Pa., No. 2x, 2.25-2.75 sil	†22.76
Virginia No. 2	†28.74
Basic	†20.75
Grey Forge	†21.75
CHICAGO	
No. 2 Foundry local	†22.70
No. 2 Foundry, Southern, sil 2.25@2.75	†26.66
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	†22.96
Basic	†21.96
Bessemer	†21.96

*F. o. b. furnace. † Delivered.

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York	Cleveland	Chicago
No. 10	2.25	3.28	3.10	3.38
No. 12	2.35	3.33	3.15	3.43
No. 14	2.45	3.38	3.20	3.48
No. 16	2.55	3.48	3.30	3.58
Black				
Nos. 17 and 21.	2.60	3.80	3.55	3.95
Nos. 22 and 24.	2.65	3.85	3.60	4.00
Nos. 25 and 26.	2.70	3.90	3.65	4.05
No. 28	2.75	4.00	3.75	4.15
Galvanized				
Nos. 10 and 11.	3.00	4.00	3.75	4.15
Nos. 12 and 14.	3.10	4.10	3.85	4.25
Nos. 17 and 21.	3.40	4.40	4.15	4.55
Nos. 22 and 24.	3.55	4.55	4.30	4.70
No. 26	3.70	4.70	4.55	4.85
No. 28	4.00	5.00	4.75	5.15

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card of Sept. 16, 1921:

BUTT WELD

Steel Inches	Black	Galv.	Iron Inches	Black	Galv.
1 to 3	68½	56	⅜ to 1¼	39½	24½
LAP WELD					
2	61½	49	2	34½	20½
2½ to 6	65½	53	2½ to 4	37½	24½
7 to 8	62½	49	4½ to 6	37½	24½
9 to 12	61½	48	7 to 12	35½	22½
BUTT WELD, EXTRA STRONG, PLAIN ENDS					
1 to 1½	66½	55	1 to 1½	39½	25½
2 to 3	67½	56			
LAP WELD, EXTRA STRONG, PLAIN ENDS					
2	59½	48	2	35½	22½
2½ to 4	63½	52	2½ to 4	38½	26½
4½ to 6	62½	51	4½ to 6	37½	25½
7 to 8	58½	45	7 to 8	30½	18½
9 to 12	52½	39	9 to 12	25½	13½

Malleable fittings. Classes B and C, Banded, from New York stock sell at net list. Cast iron, standard sizes, 20–5% off.

WROUGHT PIPE—Warehouse discounts as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	60%	46%	60½%	47½%	68½%	56%
2½ to 6 in. steel lap welded	51%	37%	58½%	44½%	65½%	53%

Malleable fittings. Classes B and C, Banded, from New York stock sell at plus 6%. Cast iron, standard sizes, 15% off.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (heavy)	5.00	6.00	8.25
Spring steel (light)	6.00	6.00	10.50
Coppered Bessemer rods (base)	8.00	8.00	6.03
Hoop steel	3.88	3.29	3.48
Cold rolled strip steel	7.50	8.25	7.25
Floor plates	4.85	2.74	5.23
Cold finished shafting or screw	4.03	3.50	4.00
Cold finished flats, squares	4.53	4.00	4.50
Structural shapes (base)	2.88	2.74	2.88
Soft steel bars (base)	2.78	2.64	2.78
Soft steel bar shapes (base)	2.78	2.64	2.78
Soft steel bands (base)	3.43	.....	.....
Tank plates (base)	2.88	2.92½	2.88
Bar iron (mill 2.25)	2.78	3.52	2.78
Drill rod (from list)	55@60%	55%	50%
Electric welding wire	New York ⅜, 8½c. per lb.		

⅛—7.15c.; 5/32 to ¼—6.75c. Swedish iron sells at 18½c. per lb. in Chicago

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			13.00
Tin, 5-ton lots, New York			27.25
Lead (up to carlots), St. Louis, 4.47½; New York			4.87½
Zinc (up to carlots), St. Louis, 4.60; New York			5.00
	New York	Cleveland	Chicago
Aluminum, 98 to 99% ingots, 1-15 ton lots	25.00	25@26	21.00
Antimony (Chinese), ton spot	5.25	6.00	6.00
Copper sheets, base	19.75	20.50	19.50
Copper wire (carlots)	15.50	15.50	14.00
Copper bars (ton lots)	18.00	22.00	17.50
Copper tubing (100-lb. lots)	19.50	23.00	19.50
Brass sheets (100-lb. lots)	15.25	18.00	15.25
Brass tubing (100-lb. lots)	18.00	20.00	18.00
Brass rods (1,000-lb. lots)	13.25	15.50	13.25
Zinc sheets (casks), (8% dis. carlots)	11.00	11.15	15.75
Nickel (ingot and shot), Bayonne, N. J.	41.00	.....	.....
Nickel (electrolytic), Bayonne, N. J.	44.00	.....	.....
Solder (½ and ½), (case lots)	19.50	23.50	17.50
Babbitt metal (best grade)	70.00	37.50	32.00
Babbitt metal (commercial)	30.00	13.50	8.00

—Shop Materials and Supplies

MONEL METAL—Base price in cents per lb., f.o.b. Bayonne N.J.:

Shot	35.00	Hot rolled machine rods (base)	53.00
Blocks	35.00	Hot rolled rods (base)	42.00
Ingots	38.00	Cold rolled rods (base)	56.00
Sheet bars	40.00	Hot rolled sheets (base)	55.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb.

Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, Grade "A" and "C" (base)	72
Copper nickel ingots	37
Hot rolled copper nickel rods (base)	45
Manganese nickel hot rolled (base) rods, "D"—low manganese	64
Manganese nickel hot rolled (base) rods "D"—high manganese	67

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	9.50	9.00	10.00
Copper, heavy, and wire	9.00	9.00	9.00
Copper, light, and bottoms	7.00	7.00	8.00
Lead, heavy	3.25	3.00	3.75
Lead, tea	2.00	2.00	2.75
Brass, heavy	5.00	5.00	7.50
Brass, light	4.00	3.00	4.50
No. 1 yellow brass turnings	4.50	4.00	5.00
Zinc	2.50	2.00	2.50

TIN PLATES—American Charcoal Plates—Bright—Cents per lb.

		New York	Cleveland	Chicago
"AAA" Charcoal Melyn Grade:				
IC,	20x28, 112 sheets	21.50	.....	.....
IX,	20x28, 112 sheets	24.00	.....	.....
IXX,	20x28, 56 sheets	13.75	.....	.....
IXXX,	20x28, 56 sheets	15.50	.....	.....
IXXXX,	20x28, 56 sheets	17.00	.....	.....
"A" Charcoal Allaways Grade:				
IC,	20x28, 112 sheets	18.50	.....	.....
IX,	20x28, 112 sheets	21.50	.....	.....
IXX,	20x28, 56 sheets	12.25	.....	.....
IXXX,	20x28, 56 sheets	14.00	.....	.....
IXXXX,	20x28, 56 sheets	15.75	.....	.....
Coke Plates, Bright				
Prime, 20x28 in.:			(56 sheets)	
80-lb,	112 sheets	13.60	.....	.....
90-lb.,	112 sheets	13.80	.....	.....
100-lb.,	112 sheets	14.00	6.50	.....
IC,	112 sheets	14.30	6.65	.....
IX,	112 sheets	16.30	.....	.....
IXX,	56 sheets	9.15	.....	.....
IXXX,	56 sheets	10.15	.....	.....
IXXXX,	56 sheets	11.15	.....	.....
Terne Plate				
Small lots, 8-lb. Coating:				
100-lb.,	14x20	7.50	6.25	6.25
IC,	14x20	7.75	6.50	6.50

SHOP SUPPLIES

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	—50%	—60%	—60-5%
1⅛ and 1¼x3 in. up to 12 in.	—40%	60-10-10%	—55%
With cold punched sq. nuts	—30%	.....	....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	—40%	.....	....
Up to 1-in. diameter, with cold punched hex. nuts (plus std. extra of 10%)	—30%	.....	.....
Button head bolts, with hex. nuts	—20%	$3.90 base	.....
Hex. head and hex. nut bolts	—20%	.....	.....
Lag screws, coach screws	—50–10%	.....	.....
Carriage bolts, all sizes up to 1 in. x 30 in.	—45%	50–10–10%	50–5%
Bolt ends, with hot pressed nuts	—50%	.....	.....
Tap bolts, hex. heads	—20%	.....	....
Rivets, $\frac{7}{16}$ in. dia. and smaller. *New list*	-50-10%	60-10-10%	-60-10%
Rivets, tinned	-50-10%	60-10-10%	—45%
Semi-finished nuts, all sizes	—70%	75%	50%
Case-hardened nuts	—60%	.....	.....
Washers, cast iron, ½ in., per 100 lb.	$5.00	$5.50 off	$4.50
Washers, cast iron, ⅝ in. and larger, per 100 lb	4.25	3.75 off	4.50
Washers, round plate, off list per 100 lb.	3.00	.....	.....
Nuts, hot pressed, sq. Off list	2.00	3.00	3.25
Nuts, hot pressed, hex. Off list	2.00	3.00	3.25
Nuts, cold punched, sq. Off list	1.50	3.00	3.00
Nuts, cold punched, hex. Off list	1.50	3.00	3.00
Rivets:			
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb	$4.40	3.50	3.68
Cone heads, ditto	4.50	3.60	3.78
1⅛ to 1¾-in. long, all diameters, *EXTRA* per 100 lb	0.25	.....	....
⅞ in. diameter *EXTRA*	0.15	.....	....
½ in. diameter *EXTRA*	0.50	.....	....
1 in. long, and shorter *EXTRA*	0.50	.....	....
Longer than 5 in. *EXTRA*	0.25	.....	....
Less than 200 lb. *EXTRA*	0.50	.....	....
Countersunk heads *EXTRA*	0.35	.....	....
Copper rivets	50–10%	40–10%	50%
Copper burs	25–10%	15%	20%

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.07½@$0.10	$0.12	$0.12
Cotton waste, mixed, per lb.	.055@.09	.09	.10
Wiping cloths per M., 13½x13½	.....	55.00	55.00
Wiping cloths per M., 13½x20½	.....	65.00	65.00
Sal soda, 100 lbs	2.10	3.00	2.65
Roll sulphur, 2-bbl. lots per 100 lb	2.55	3.25	2.75
Linseed oil, per gal., 5 bbl. lots	.80	.88	.87
White lead, dry or in oil	100 lb. kegs.	New York, 12.25	
Red lead, dry	100 lb. kegs.	New York, 12.25	
Red lead, in oil	100 lb. kegs.	New York, 13.75	
Fire clay, per 100 lb		.80	.80
Coke, prompt furnace, Connellsville	per ton	$3.25@3.40	
Coke, prompt foundry, Connellsville	per ton	4.25@4.50	

MIDDLE ATLANTIC STATES

N. J., Atlantic City—The Union Transfer Co., 1004 Spring Garden St., Phila., Pa., has had plans prepared for the construction of a 1 story, 60 x 150 ft. and 105 x 105 ft. garage here. C. J. Mitchell, 129 South 15th St., Phila., Pa., Archt.

N. J., Mt. Holly—W. A. Jones is having plans prepared for the construction of a 1 and 2 story, 100 x 200 ft. garage and service station on Washington and King Sts. Estimated cost, $70,000. Folsom & Stanton, 10 South 18th St., Phila., Pa., Archts.

N. J., Newfield — The Wilcox-Durand Glass Co. will build a 1 story, 31 x 101 ft. machine shop. Estimated cost, $25,000. W. P. Cameron Eng. Co., Witherspoon Bldg., Phila., Pa., Engrs.

N. J., Wildwood—W. Butterfield is having plans prepared for the construction of a 1 story, 40 x 80 ft. machine shop on Roberts Ave. Estimated cost, $5,000. L. Boyer, Wildwood, Archt.

Pa., Philadelphia—The city has awarded the contract for the construction of a 1 story, 160 x 220 ft. repair shop on 29th and Cambria Sts. Estimated cost, $115,000. Noted April 14.

MIDDLE WEST STATES

Ill., Chicago—The North Amer. Car Co., 328 South La Salle St., is having plans prepared for the construction of a 1 story, 80 x 125 ft. car erection plant on 135th and California Aves. Estimated cost, $40,000. Private plans.

Ill., Granite City — The Cabaret Range Co. is having plans prepared for the construction of a range plant consisting of two 70 x 300 ft., one 24 x 70 ft. and one 70 x 100 ft. buildings. Estimated cost, $300,000. C. Pauley & Son, 19th and C Sts., Archts.

Ill., Waukegan—J. P. Heath & Co., manufacturers of architectural bronze, has awarded the contract for the construction of a 2 story, 100 x 108 ft. machine shop. Estimated cost, $100,000.

Mich., Iron Mountain — The Michigan Land & Lumber Co., subsidiary of Ford Motor Co., Detroit, has awarded the contract for the construction of a 1 story, 120 x 300 ft. plant for the manufacture of auto bodies.

O., Cleveland—Carris-Franklin Sales Co., 3622 Prospect Ave., is having plans prepared for the construction of a 1 story, 100 x 140 ft. garage. Estimated cost, $60,000. Carter, Richards & Griffith Co., Illuminating Bldg., Archts.

O., Cleveland—The Chicago Roller Co., 554 Harrison St., Chicago, Ill., has awarded the contract for the construction of a 2 story, 50 x 92 ft. factory at 1432 Hamilton Ave., here. Estimated cost, $40,000.

O., Cleveland—The Cooley Co., c/o E. A. Markham, 4 Euclid Ave. and 105th Market St., manufacturers of electric appliances, has awarded the contract for the construction of a 1 and 2 story, 39 x 102 ft. factory at 4516 Superior Ave. Estimated cost, $40,000.

O., Cleveland—J. L. Free Land Co., 1004 Prospect Ave., has awarded the contract for the construction of a 1 story, 40 x 78 ft. garage at 4917 Prospect Ave. Estimated cost, $40,000.

O., Cleveland—The Greenline Garage & Supply Co., 4214 West 25th St., has awarded he contract for the construction of a 1 story, 43 x 89 ft. garage on Memphis Ave. Estimated cost, $40,000.

O, Cleveland—The Overland-Larick Co., c/o J. J. Larick, 18526 St. Clair Ave., has awarded the contract for the construction of a 1 story, 65 x 150 ft. garage on East 152d St. and St. Clair Ave. Estimated cost, $50,000.

O., Cleveland—The Rail Welding & Bonding Co., 2400 Woodland Ave., has awarded the contract for the construction of a 1 story, 90 x 180 ft. factory. Estimated cost, $60,000.

O., Cleveland—M. H. and I. Stone, Kirby Bldg., are receiving bids for the construction of a 1 story, 40 x 56 ft. garage at 2150 East 35th St. Estimated cost, $40,000. Private plans.

O., Cleveland—The Vichek Tool Co., 3000 East 87th St., has awarded the contract for the construction of a 1 story, 40 x 50 ft. factory on East 87th St. Estimated cost, $50,000.

O., Lakewood—J. G. Stern, c/o J. C. Froelick, 214 Williamson Bldg., Cleveland, plans to build a 1 story, 70 x 120 ft. garage, on Madison and Clarence Aves. Estimated cost, $50,000. Private plans.

Wis., Oshkosh—Auler & Jensen, Archts., F. R. A. Bldg., are receiving bids for the construction of a 4 story, 150 x 375 ft. tractor factory on New York St., for the Oshkosh Tractor Co., c/o A. D. Paine, 22 East New York St. Estimated cost, $170,000.

Wis., Oshkosh—R. Lutz, 1270 Knapp St., will build a 2 story, 40 x 80 ft. garage. Estimated cost, $40,000. Auler & Jensen, F. R. A. Bldg., Archts.

Wis., Oshkosh—The Oshkosh Tractor Co., 22 New York Ave., will soon award the contract for the construction of a 1 and 2 story, 150 x 500 ft. and 25 x 100 ft. factory. Estimated cost, $170,000. Auler & Jensen, F. R. A. Bldg., Archts.

Wis., Saukville—A. Horn has had plans prepared for the construction of a 1 and 2 story, 40 x 139 ft. garage and machine shop on Main St. Estimated cost, $45,000. W. F. Hilgen, Cedarburg, Archt.

Wis., Milwaukee—S. D. Austin, 307 Grand Ave., has awarded the contract for the construction of a 1 story, 90 x 120 ft. garage on Oakland Ave. Estimated cost, $45,000.

Wis., Milwaukee—The Dort Motor Co., 242 4th St., is having plans prepared for the construction of a 1 story, 120 x 120 ft. garage on Mason St. Estimated cost, $42,000. A. C. Eschweiler, 141 Wisconsin St., Archt.

Wis., Milwaukee—Pauly & Marx, 2530 North Ave., have awarded the contract for the construction of a 1 and 2 story, 116 x 130 ft. garage on North Ave. Estimated cost, $50,000. Noted Sept. 15.

Wis., Milwaukee—The F. Rosenberg Elevator Co., 174 Reed St., has awarded the contract for the construction of a 1 and 2 story, 120 x 223 ft. factory on Richard and Franklin Sts. Estimated cost, between $60,000 and $75,000. Noted Sept. 1.

Wis., Milwaukee—Smith Eng. Wks., 1154 32nd St., has awarded the contract for the construction of a 1 story, 75 x 100 ft. assembling plant on 32nd St. Estimated cost, $40,000.

Wis., Milwaukee—The Van Buren Garage Co., 174 Ogden Ave., has awarded the contract for the construction of a 2 story, 57 x 127 ft. garage on Van Buren St. Estimated cost, $70,000. Noted Sept. 15.

WEST OF THE MISSISSIPPI

Colo., Denver—The Hardesty Mfg. Co., 1833 Market St., manufacturers of sheet metal products, has had plans prepared for the construction of a factory, consisting of 2 buildings, 100 x 160 ft. and 120 x 160 ft., on 30th and Blake Sts. Estimated cost, between $75,000 and $100,000. C. S. Lambie, Tramway Bldg., Engr.

Kan., Kansas City—The Pennsylvania Tank Line Co., c/o R. W. Lowrey, Mgr., has awarded the contract for the construction of a 1 story, 80 x 300 ft. and 80 x 200 ft. repair plant on 40th and Augusta Sts. Estimated cost, $150,000.

Minn., St. Paul—The Owen Motor Sales Co., 713 University Ave., has awarded the contract for the construction of 1 and 2 story additions to garage. Estimated cost, $40,000. Noted June 9.

Tex., Dallas—J. T. and J. H. Jones, 2401 Travis St., Houston, have awarded the contract for the construction of a 2 story, 100 x 100 ft. garage. Estimated cost, $65,000.

CANADA

Que., Montreal—P. Labelle, 721 Dorchester St., has awarded the contract for the construction of a 3 story, 114 x 175 ft. garage on Argyle and Overdale Sts. Estimated cost, $150,000.

General Manufacturing

NEW ENGLAND STATES

Conn., Hartford—Buck & Sheldon, Inc., Archts. and Engrs., 60 Prospect St., will open bids about Oct. 3 for the construction of a 1 story, 100 x 110 ft. printing and engraving plant on Franklin Ave., for R. S. Peck & Co., 26 High St.

Mass., Boston—The Womens Educational & Industrial Union, 264 Boylston St., has awarded the contract for the construction of a 4 story manufacturing plant and laboratory on Bway. Ext. and Fayette St. Estimated cost, $100,000. Gay & Proctor, 50 Bromfield St., Archt.

R. I., Providence—W. R. Walker & Son, Archts., 49 Weybosset St., are receiving bids for the construction of a 2 story, 50 x 76 ft. starch factory on South Water and Coin Sts., for C. S. Tanner & Co., 250 South Water St. Estimated cost $40,000. Noted Sept. 22.

MIDDLE ATLANTIC STATES

N. Y., Buffalo—J. N. Matthews Co., Washington and Exchange Sts., has had plans prepared for the construction of a 3 story, 100 x 150 ft. publishing plant on Oak St. Estimated cost to exceed $200,000. R. J. Reidpath & Son, Mutual Life Bldg., Engrs.

Pa., McKees Rock—W. L. Singer Ice Co. has had plans prepared for the construction of a 1 story, 50 x 60 ft. ice plant. Estimated cost, $60,000. A. C. Bishop & Co., 427 Guardian Bldg., Cleveland, O., Archts. and Engrs.

Pa., Philadelphia—The Forrest Laundry, 1225 Columbia Ave., has awarded the contract for the construction of a 1 and 2 story, 48 x 53 ft. and 33 x 53 ft. laundry at 1704-12 North Tawn St. Estimated cost, $30,000.

Pa., Williamsburg—The Coleman Lumber Co. plans to rebuild its saw mill which was recently destroyed by fire. Estimated cost, $25,000. J. Coleman, Pres.

SOUTHERN STATES

Fla., Sarasota—The Sarasota Bee Co. plans to build a factory for the manufacture of bee hives, beekeepers' supplies, window sashes, door frames, blinds, etc.

MIDDLE WEST STATES

Ill., Moline—The Moline Daily Despatch, 1509 3d Ave. A., plans to build a 2 story publishing plant. Estimated cost, $115,000. Architect not selected.

Wis., Antigo—Mattefs Bros., c/o G. Mattefs, Pres., plans to build a 2 story, 60 x 180 ft. factory on Main St., for the manufacture of wood products. Estimated cost, $150,000. Architect not selected, probably private plans.

Wis., Appleton Jct.—The Traas Candy Co., 715 College Ave., Appleton, is having plans prepared for the construction of a 2 story, 45 x 100 ft. factory, here. Estimated cost, $50,000. W. Sindahl, Neenah, Archt.

Wis., Fon-du-Lac—The Galloway West Co., 24 West Division St., is having preliminary plans prepared for the construction of a 3 or 4 story, 64 x 160 ft. cold storage warehouse on West Division St. Estimated cost, $75,000. M. Tullgren & Sons, 425 East Water St., Milwaukee, Archts.

O., Cleveland—The City Ice & Fuel Co. is receiving bids for the construction of a 1 story, 52 x 75 ft. ice plant on Addison Rd. Estimated cost, $75,000. C. C. Coneby, Cadillac Bldg., Archt. and Engr.

O., Lakewood—The City Ice & Fuel Co., East 22nd St., Cleveland, has awarded the contract for the construction of a 1 story ice plant on Fisher and Warren Rds., here. Estimated cost, $100,000.

O., Youngstown—The Distilled Water Ice Co., 523 West Federal St., has had plans prepared for the construction of a 1 story, 70 x 160 ft. ice plant on Federal St. Estimated cost, $100,000. A. C. Bishop & Co., 427 Guardian Bldg., Cleveland, Archts. and Engrs.

Wis., Milwaukee—The Sonnenberg Sausage Co., 92 Michigan St., has awarded the contract for the construction of a sausage factory on 32nd St. Estimated cost, $25,000.

Wis., Neenah—The Valley Paper Mills, East Wisconsin Ave., will receive bids about Oct. 15 for the construction of a 1 and 2 story, 80 x 550 ft., paper mill, etc. Estimated cost, $800,000. Noted July 26.

Wis., Sheboygan—The Ke-No Mfg. Co., Pennsylvania Ave. and East Water St., is having plans prepared for the construction of a 2 and 3 story, 60 x 100 ft. factory on Pennsylvania Ave., for the manufacture of furniture novelties. Estimated cost, $65,000. W. C. Weeks, 720 Ontario Ave., Archt.

Wis., Waupun—C. Snyder and K. Wessel, 1285 Como Blvd., St. Paul, Minn., plan to build a 2 or 4 story, 60 x 210 ft. hemp factory, here Estimated cost, $100,000. Architect not selected.

WEST OF THE MISSISSIPPI

Mo., Sedalia—Swift & Co., c/o G. H. Trader, local Mgr., has awarded the contract for the construction of a 2 story, 100 x 200 ft. packing plant. Estimated cost, $175,000.

Okla., Oklahoma City—P. H. Anthony, Archt., Waldheim Bldg., Kansas City, Mo., will receive bids until Oct. 4 for the construction of a bakery for the Smith Baking Co., 437 West Park St. Estimated cost, $150,000.

CANADA

Ont., Windsor—The Essex Provision Co., Ltd., 1120 McDougall St., has awarded the contract for the construction of a 4 story, 280 x 300 ft. packing and cold storage plant on McDougall St. Estimated cost, $500,000. Noted Aug. 18.

Que., Montreal—J. J. Joubert, Ltd., St. Andre St., plans to build a 2 story, 50 x 80 ft. addition to ice plant. Estimated cost, $40,000. Private plans.